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Includes aeronautics (general); aerodynamics; air transportation and safety; aircraft communications and navigation; aircraft design, testing and performance; aircraft instrumentation; aircraft propulsion and power; aircraft stability and control; and research and support facilities (air).

For related information see also *Astronautics*.

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For related information see also *07 Aircraft Propulsion and Power, 28 Propellants and Fuels,* and *44 Energy Production and Conversion*.

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Includes iteration, difference equations, and numerical approximation.

**65 STATISTICS AND PROBABILITY** 1368
Includes data sampling and smoothing; Monte Carlo method; and stochastic processes.

**66 SYSTEMS ANALYSIS** 1370
Includes mathematical modeling; network analysis; and operations research.

**67 THEORETICAL MATHEMATICS** N.A.
Includes topology and number theory.

## PHYSICS

Includes physics (general); acoustics; atomic and molecular physics; nuclear and high-energy physics; optics; plasma physics; solid-state physics; and thermodynamics and statistical physics.
For related information see also *Engineering*.

**70 PHYSICS (GENERAL)** 1370
For geophysics see *46 Geophysics*. For astrophysics see *90 Astrophysics*. For solar physics see *92 Solar Physics*.

**71 ACOUSTICS** 1370
Includes sound generation, transmission, and attenuation.
For noise pollution see *45 Environment Pollution*.

**72 ATOMIC AND MOLECULAR PHYSICS** 1371
Includes atomic structure and molecular spectra.

**73 NUCLEAR AND HIGH-ENERGY PHYSICS** 1372
Includes elementary and nuclear particles; and reactor theory.
For space radiation see *93 Space Radiation*.

**74 OPTICS** 1372
Includes light phenomena.

**75 PLASMA PHYSICS** 1374
Includes magnetohydrodynamics and plasma fusion.
For ionospheric plasmas see *46 Geophysics*. For space plasmas see *90 Astrophysics*.

**76 SOLID-STATE PHYSICS** 1378
Includes superconductivity.
For related information see also *33 Electronics and Electrical Engineering* and *36 Lasers and Masers*.

**77 THERMODYNAMICS AND STATISTICAL PHYSICS** 1381
Includes quantum mechanics; and Bose and Fermi statistics.
For related information see also *25 Inorganic and Physical Chemistry* and *34 Fluid Mechanics and Heat Transfer*.

## SOCIAL SCIENCES

Includes social sciences (general); administration and management; documentation and information science; economics and cost analysis; law and political science; and urban technology and transportation.

**80 SOCIAL SCIENCES (GENERAL)** 1382
Includes educational matters.

**81 ADMINISTRATION AND MANAGEMENT** 1382
Includes management planning and research.

**82 DOCUMENTATION AND INFORMATION SCIENCE** 1382
Includes information storage and retrieval technology; micrography; and library science.
For computer documentation see *61 Computer Programming and Software*.

**83 ECONOMICS AND COST ANALYSIS** 1383
Includes cost effectiveness studies.

**84 LAW AND POLITICAL SCIENCE** N.A.
Includes space law; international law; international cooperation; and patent policy.

**85 URBAN TECHNOLOGY AND TRANSPORTATION** 1383
Includes applications of space technology to urban problems; technology transfer; technology assessment; and surface and mass transportation.
For related information see *03 Air Transportation and Safety*, *16 Space Transportation*, and *44 Energy Production and Conversion*.

## SPACE SCIENCES

Includes space sciences (general); astronomy; astrophysics; lunar and planetary exploration; solar physics; and space radiation.
For related information see also *Geosciences*.

**88 SPACE SCIENCES (GENERAL)** N.A.

**89 ASTRONOMY** 1387
Includes radio and gamma-ray astronomy; celestial mechanics; and astrometry.

**90 ASTROPHYSICS** 1388
Includes cosmology; and interstellar and interplanetary gases and dust.

**91 LUNAR AND PLANETARY EXPLORATION** 1388
Includes planetology; and manned and unmanned flights.
For spacecraft design see *18 Spacecraft Design, Testing and Performance*. For space stations see *15 Launch Vehicles and Space Vehicles*.

**92 SOLAR PHYSICS** 1389
Includes solar activity, solar flares, solar radiation and sunspots.

**93 SPACE RADIATION** 1390
Includes cosmic radiation; and inner and outer earth's radiation belts.
For biological effects of radiation see *52 Aerospace Medicine*. For theory see *73 Nuclear and High-Energy Physics*.

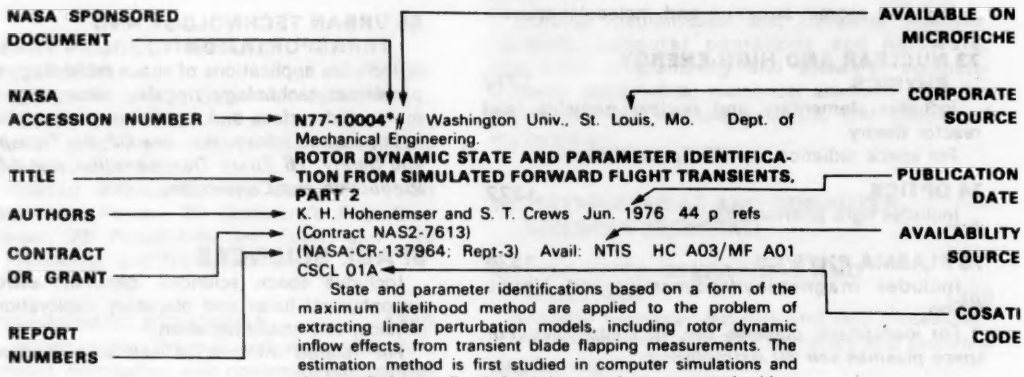
## GENERAL

**99 GENERAL** N.A.

Note: N.A. means that no abstracts were assigned to this category for this issue.

**SUBJECT INDEX** ..... I-1
**PERSONAL AUTHOR INDEX** ..... I-51
**CORPORATE SOURCE INDEX** ..... I-59
**CONTRACT NUMBER INDEX** ..... I-73
**REPORT/ACCESSION NUMBER INDEX** ..... I-77

# TYPICAL CITATION AND ABSTRACT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N77-10004*# Washington Univ., St. Louis, Mo. Dept. of Mechanical Engineering.
ROTOR DYNAMIC STATE AND PARAMETER IDENTIFICATION FROM SIMULATED FORWARD FLIGHT TRANSIENTS, PART 2
K. H. Hohenemser and S. T. Crews Jun. 1976 44 p refs
(Contract NAS2-7613)
(NASA-CR-137964; Rept-3) Avail: NTIS HC A03/MF A01
CSCL 01A
State and parameter identifications based on a form of the maximum likelihood method are applied to the problem of extracting linear perturbation models, including rotor dynamic inflow effects, from transient blade flapping measurements. The estimation method is first studied in computer simulations and then applied to cyclic pitch stirring transients generated with a four-bladed rotor model operating in hovering trim conditions. The analytical perturbation models extracted from the transient test results are compared with transient and frequency response tests not used in the state and parameter identification. The identified analytical perturbation model is also compared with a simple theory. The method that is applicable both to small scale and full scale dynamic rotor testing is being extended to perturbations from forward flight trim conditions. Author

# ON-GOING RESEARCH PROJECTS

*This is a listing of research projects - not publications*

## AERONAUTICS

Includes Aeronautics (general); Aerodynamics; Air Transportation and Safety; Aircraft Communications and Navigation; Aircraft Design, Testing, and Performance; Aircraft Instrumentation; Aircraft Propulsion and Power; Aircraft Stability and Control; and Research and Support Facilities (air). For Related Information See Also Astronautics.

**1.0001, DEVELOPMENT OF BORON/ALUMINUM LANDING GEAR COMPONENTS**
*F. DOYAL*, General Dynamics Corporation, *San Diego, California* 92112 (DN581070; N62269-74-C-0619)

To evaluate the application of boron/aluminum composites to landing gear components of Navy aircraft with emphasis on component reliability. This work is in support of work unit ZA101, Aircraft Technology, agency accession no. DN681080.

The component selected for development is the A-7 nose gear drag brace. The conventional brace is representative of the typical steel I section components found in landing gear. This will be replaced with a tubular brace fabricated of boron/aluminum (B/Al) with titanium end fittings. The effects of damage and corrosion on static and fatigue strength of these braces will be evaluated. In total, 8 braces will be fabricated and subjected to various combinations of environments, including static and fatigue loading, foreign particle impact, and corrosion.

ADDENDA: Supporting agency address is: Naval Air Development Center (30331), Warminster, Pennsylvania 18974

SUPPORTED BY U.S. Dept. of Defense - Navy

**1.0002, INVESTIGATION OF PREDICTIVE DISPLAY SYMBOLOGY FOR TERMINAL CONFIGURED VEHICLE**
*R.S. JENSEN*, Univ. of Illinois, Inst. of Aviation, *Urbana, Illinois* 61801 (NAS 1-14731)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**1.0003, SUPERIMPOSED DISPLAY SYMBOLOGY AS A LANDING AID FOR HELICOPTERS**
*T.A. DUKES*, Princeton University, School of Engin. & Appl. Sci., *Princeton, New Jersey* 08540 (NAS 2-9437)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**1.0004, ANTENNA AND RADIOMETRIC LOSS MEASUREMENTS FOR AIRCRAFT INSTRUMENTATION RESEARCH PROJECT**
*D.G. HENRY*, New Mexico State University, Graduate School, *Las Cruces, New Mexico* 88001 (NAS 9-95477)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**1.0005, AIRCRAFT NOISE ADAPTATION STUDY**
*E. GALANTER*, Columbia University, School of Arts & Sciences, *New York, New York* 10027 (NAS 1-14745)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

## ASTRONAUTICS

Includes Astronautics (general); Astrodynamics; Ground Support Systems and Facilities (space); Launch Vehicles and Space Vehicles; Space Transportation; Spacecraft Communications; Command and Tracking; Spacecraft Design, Testing, and Performance; Spacecraft Instrumentation; and Spacecraft Propulsion and Power. For Related Information See Also Aeronautics.

**2.0001, BUFFETING OF SPACE PROBES**
*V.U. MUIRHEAD*, Univ. of Kansas, School of Engineering, *Lawrence, Kansas* 66044 (NCA 2-365702)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**2.0002, DESIGN, FABRICATE AND TEST FIVE PAYLOADS**
*J.J. HORVATH*, Univ. of Michigan, School of Engineering, *Ann Arbor, Michigan* 48106 (NAS 6-2794)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

## CHEMISTRY AND MATERIALS

Includes Chemistry and Materials (general); Composite Materials; Inorganic and Physical Chemistry; Metallic Materials; Nonmetallic Materials; and Propellants and Fuels.

**3.0001, EVALUATIVE STUDY OF SEVERAL PHOTOPOLYMER HOLOGRAPHIC DETECTOR MATERIALS**
*G.L. WORKMAN*, Athens College, Undergraduate School, *Athens, Alabama* 35611 (NAS 8-32221)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**3.0002, GRAIN QUALITY INSPECTION SYSTEM PHASE I FEASIBILITY EVALUATION**
*C.A. FLOOD*, Auburn University, School of Agriculture, *Auburn, Alabama* 36830 (NSG 8047)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**3.0003, INVESTIGATION OF THE SYNTHESIS OF OPTICALLY AC POLYMERS**
*G.U. YUEN*, Arizona State University, School of Liberal Arts, *Tempe, Arizona* 85281 (NCA 2-35702)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**3.0004, STUDY OF CHEMICAL EVOLUTION INTERACTIONS OF METAL IONS AND NUCLEOTIDES**
*A.L. FURST*, Univ. of California, Lawrence Berkeley Laboratory, *Berkeley, California* 94720 (NAS 2-9440)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**3.0005, THE CATALYTIC ACTIVITY AND SELECTIVITY OF SUPPORTED METAL CATALYSTS**
*G.M. POUND*, Stanford University, School of Engineering, *Palo Alto, California* 94305 (NCA 2-745711)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**3.0006, BINDING INTERACTIONS OF 5' NUCLEOTIDES AND THEIR DERIVATIVES WITH AMINO ACIDS**
*J.B. ORENBERG*, Calif. State Univ. & Colleges, School of Natural Sciences, *San Francisco, California* 94132 (NCA 2-660701)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**3.0007, PREPARATION AND TESTING OF FIRE EXTINGUISHMENT CHEMICALS SUITABLE FOR ENGINE NACELLE FIRE CONTROL IN AIRCRAFT**
*A.C. LING*, Calif. State Univ. & Colleges, School of Science, *San Jose, California* 95114 (NCA 2-675706)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**3.0008, THE INTERACTION OF NUCLEOTIDES WITH MOLYBDENUM**
*M.A. SWEENEY*, Univ. of Santa Clara, School of Science, *Santa Clara, California* 95053 (NCA 2-685706)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**3.0009, NAVY VEHICLE DESIGN AND CONSTRUCTION - MECHANICAL BEHAVIOR OF TITANIUM ALLOYS**
*N.E. PATON*, Rockwell International Corp., *Thousand Oaks, California* 91360 (DN675316; N00014-76-C-0598)

Titanium is an important structural material for use in aircraft and ships. Microstructure as controlled by processing affects the properties of titanium and its ultimate applications. This research effort will be directed towards improving the toughness of titanium by modifying the microstructure.

The research is divided into two phases. Phase I examines the structure and properties of annealed titanium 6-4. In particular formation of the interface phases present at alpha-beta interfaces (under certain processing conditions) will be studied for the effects on strength and toughness. The kinetics of formation and crystallography of the interface phases will be found. In phase II the effect of hydrogen on elastic modulus and strength will be explored in beta titanium alloys. Model alloys and commercial beta III will be included in the program.

ADDENDA: Supporting agency address is: Office of Naval Research, Arlington, VA 22217

SUPPORTED BY U.S. Dept. of Defense - Navy

**3.0010, MAGNETIC ORDER IN NICKEL-MANGANESE ALLOYS**
*C.E. PATTON*, Colorado State University, School of Natural Sciences, *Fort Collins, Colorado* 80521 (DMR76-23623)

Research on ordered and disordered Ni-Mn alloys near the Ni3Mn composition will be carried out using magnetization, Hall Effect, and neutron scattering techniques. The goal is to establish the composition dependence of the effective exchange anisotropy and the relative strengths of the Ni-Mn and Mn-Mn exchange interactions. The neutron scattering work is to establish the degree of atomic order, the size of magnetic clusters and short-range magnetic order between these clusters. An effort will be made to establish a magnetic phase diagram for the Ni- Mn system.

This is a continuation of research supported under DMR73-02665.

SUPPORTED BY U.S. Natl. Science Foundation

**3.0011, THERMAL ENVIRONMENT EFFECTS ON STRUCTURES OF COMPOSITE MATERIALS**
*R.L. DAUGHERTY*, Univ. of Delaware, School of Engineering, *Newark, Delaware* 19711 (NSG 1368)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**3.0012, ELASTIC-PLASTIC FINITE ELEMENT ANALYSES OF FATIGUE CRACK GROWTH IN MODE I AND MODE II CONDITIONS**
*S.N. ATLURI*, Georgia Inst. of Technology, School of Engin. Sci. & Mech., *Atlanta, Georgia* 30332 (NSG 1351)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**3.0013, COMPARATIVE EVALUATION OF WOVEN-GRAPHITE-EPOXY COMPOSITES**
*S.V. HANAGUD*, Georgia Inst. of Technology, School of Aerospace Engin., *Atlanta, Georgia* 30332 (NSG 1352)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**3.0014, DYNAMIC FRACTURE AND CRACK ARREST IN ADVANCED FIBER COMPOSITES**
*J.H. WILLIAMS*, Mass. Inst. of Technology, School of Engineering, *Cambridge, Massachusetts* 02139 (NSG 1349)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**3.0015, ELECTROCHEMICAL CARBON OXIDE CONCENTRATION USING MOLTEN-SALT ELECTROLYTES**
*J. WINNICK*, Univ. of Missouri, School of Engineering, *Columbia, Missouri* 65201 (NSG 2193)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**3.0016, COMBUSTION CHARACTERISTICS OF HIGH-DENSITY FUELS**
*W.B. BIRK*, U.S. Navy, Air Propulsion Test Center, *Trenton, New Jersey* 08641 (DN596809)

Determine the combustion characteristics of high-density fuels and compare to those of JP-5 fuels. Define limiting performance of high- density fuels in terms of engine limitations (starting capability, combustion stability, etc.). Define combustion system improvements which would permit significant gains in the utilization of high-density fuels.

Utilizing various high-density fuels and blends thereof, perform tests in a full-scale single combustor rig (T58 combustor) to determine combustion efficiency, stability of combustion and starting capabilities at various air pressures and temperatures and fuel temperatures. Through data analysis, establish overall relationship of maximum Btu content of fuel which can be utilized for any mission, taking into consideration gas turbine engine combustion system limitations and mission operational environment conditions.

ADDENDA: Supporting agency address is: Naval Air Systems Command, Propulsion Technology Administrator, Washington, D. C. 20361

SUPPORTED BY U.S. Dept. of Defense - Navy

**3.0017, IRRADIATION DAMAGE STUDIES BY HIGH-VOLTAGE ELECTRON MICROSCOPY**
*T.E. MITCHELL*, Case Western Reserve Univ., School of Engineering, *Cleveland, Ohio* 44106 (E(11-1)-2119)

The objective of the research is to study electron irradiation damage in a variety of materials. High-voltage electron microscopy is to be used to produce vacancies and interstitials by displacement and to observe their agglomeration into loops and voids and their effects on diffusion-controlled processes such as precipitation. Quantitative results will be obtained on loop and void forma-

tion and growth, radiation-enhanced nucleation and growth of precipitates, and threshold displacement energies. Materials to be studied include a variety of pure metals and some alloys for threshold displacement energies, aluminum and nickel alloys and stainless steels for defect clustering and precipitation studies, and various ceramic oxides for threshold and defect clustering studies. In addition the different effects of both displacement damage and ionization damage are to investigated in some simple glass-forming materials (SiO2, BeF2,B2O3).

RESULTS: The threshold displacement energy Ed has been determined in a variety of pure metals, alloys and oxides and is found to be approximately 5 times the sublimation energy. The orientation dependence of Ed can be explained in terms of the crystal structures. Effects of irradiation on precipitation in Al-Cu, Al-Si and Ni-Al alloys have been studied. Enhanced growth of both theta prime and gamma prime can be explained quantitatively in terms of linear annealing of point defects to the precipitates. In MgO, Al2O3, and SiO2, displacement damage is observed (loop formation) but in SiO2 ionization damage is also observed (destruction of crystallinity).

SUPPORTED BY U.S. Energy Res. & Dev. Admin. - P.R.D.

**3.0018, HETEROGENEOUS CHEMICAL REACTIONS PREPARATIONAL MONODISPERSE LATEXES**
*J. VANDERHOFF*, Lehigh University, School of Arts & Sciences, *Bethlehem, Pennsylvania* 18015 (NAS 8-32399)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**3.0019, DEVELOPMENT OF A PREDICTIVE MODEL FOR THERMAL AND THERMO-OXIDATIVE STABILITY OF PMR POLYMIDE GRAPHITE FIBER COMPOSITES**
*W.J. SNYDER*, Bucknell University, School of Engineering, *Lewisburg, Pennsylvania* 17837 (NSG 3136)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**3.0020, CYCLIC STRESS-STRAIN BEHAVIOR OF PRECIPITATION-HARDENED ALLOYS STRENGTHENED BY MODULATED STRUCTURES**
*W.A. SOFFA*, Univ. of Pittsburgh, School of Engin. & Appl. Sci., *Pittsburgh, Pennsylvania* 15260 (DMR76-81347)

This is a study of the cyclic stress-strain response of high-strength precipitation-hardened Cu-Ti, Cu-Ti-Al, and Cu-Ni-Cr alloys strengthened by spinodal or modulated structures. A critical examination of the dissolution and disordering hypotheses of microstructural instability and fatigue softening in alloys containing particles which are sheared during plastic deformation will be undertaken. The combined phenomenological and metallographic study is expected to establish whether particular thermodynamic/kinetic aspects of spinodal precipitation or general morphological features of the modulated structures can be used to enhance fatigue resistance. This is a renewal of NSF Grant DMR73-02436 A01.

SUPPORTED BY U.S. Natl. Science Foundation

**3.0021, STUDY OF ELASTOMER-MODIFIED POLYIMIDE SYSTEMS**
*A.V. GALANTI*, Penn. State University, Graduate School, *University Park, Pennsylvania* 16802 (NSG 1359)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**3.0022, INVESTIGATION AND CHARACTERIZATION OF CONSTRAINT EFFECTS ON FLAW GROWTH DURING FATIGUE LOADING OF COMPOSITE MATERIALS**
*K.L. REIFSNIDER*, Virginia Poly. Inst. & St. U., School of Engineering, *Blacksburg, Virginia* 24061 (NSG 1364)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**3.0023, CRYSTALLOGRAPHY AND STRUCTURAL PROPERTIES OF CHEMISORBED LAYERS ON METAL AND ALLOY SURFACES**
*M.G. LAGALLY*, Univ. of Wisconsin, School of Engineering, *Madison, Wisconsin* 53706 (DMR76-24221)

The description of the surface chemical bond for simple adsorbate systems is a necessary first step to understanding more complex surface interactions such as chemical reactions. This requires information about the structural properties of the surface and adsorbed layer. The equilibrium positions and other geometric parameters in metals and alloys, both clean and with chemisorbed layers, will be studied using low-energy electron diffraction (LEED) as the main tool. A more rapid and accurate means of accumulating LEED intensity data, using an optical multichannel analyzer, will be developed and used for structural determinations and thermal-dependence measurements. Properties of the adatom-substrate interaction potential relatable to temperature will be studied for chemisorption on W. As a first step to investigating chemisorption on alloys the crystallography of the alloy surfaces Cu3Au(100) and NiPd(100) will be investiated using Constant Momentum Transfer Averaging of LEED intensities.

This is a continuation of research supported under DMR72-03249A02.

SUPPORTED BY U.S. Natl. Science Foundation

## ENGINEERING

Includes Engineering (general); Communications; Electronics and Electrical Engineering; Fluid Mechanics and Heat Transfer; Instrumentation and Photography; Lasers and Masers; Mechanical Engineering; Quality Assurance and Reliability; and Structural Mechanics. For Related Information See Also Physics.

**4.0001, COMPOSITE MOBILE HOLOGRAPHIC NON-DESTRUCTIVE TEST SYSTEM ANALYSIS**
*H.K. LIU*, Univ. of Alabama, School of Engineering, *Tuscaloosa, Alabama* 35486 (NAS 8-32386)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**4.0002, APPLICATION OF ADAPTIVE FILTERS TO ENHANCEMENT OF GEOMAGNETIC DATA**
*W.M. FAIRBANK*, Stanford University, School of Hum. & Sciences, *Palo Alto, California* 94305 (NCA 2-745708)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**4.0003, SIMULATION DEVELOPMENT FOR MULTIPLE WARNING DISPLAY EXPERIMENTATION**
*D.A. THOMPSON*, Stanford University, School of Engineering, *Palo Alto, California* 94305 (NCA 2-745710)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**4.0004, TECHNICAL ASSISTANCE FOR THE DEVELOPMENT AND EVALUATION OF AIRBORNE VLF NAVIGATION SYSTEMS**
*UNKNOWN*, Systems Control Incorporated, *Palo Alto, California* 94306 (FA58654; FA75WA-3662)

Tasks include: 1) Preparation of Engineering Requirements 2) Development and Evaluation of Noise Cancellation Antenna System 3) Evaluation of 3.4 kHz Omega Airborne Receiver 4) Development and Evaluation of Civil Omega/VLF Airborne System 5) Development and Evaluation of Operation Type Differential Omega System 6) Low Cost VLF Airborne Systems Evaluations 7) VLF Navigation System Study 8) Definitive Analysis of the Role of VLF Navigation in Aviation.

SUPPORTED BY U.S. Dept. of Transportation - Off. Sec.

**4.0005, DOPPLER RADAR DEVELOPMENT**
*R.G. STRAUCH*, U.S. Dept. of Commerce, Environmental Research Labs., *Boulder, Colorado* 80302 (8C37 01 60)

PROJECT OBJECTIVE: Design, assemble, and test Doppler radar systems for use in meteorological studies. Develop methods of processing Doppler data in a form useful for meteorological analysis. The long-term goal is to develop a real-time display of velocity fields.

CURRENT YEAR PLAN: Conduct experiments using multiple Doppler radars on boundary layer processes, using chaff targets, convective storms cells, and snowstorms. Develop mobile Doppler. Develop dual pulse transmission and associated Doppler data processing system. Develop NOVA software for off-line processing and editing of data.

PROGRESS REPORT: A dual Doppler (mobile) X-band radar system is operational. Dual Doppler data were acquired by the radars on the Olympic Peninsula in Washington State, during project METROMEX in 1975 (in St. Louis), and in NHRE, 1976. The NHRE project involved the coordinated operation of both WPL Doppler radars and 2 Doppler radars from NCAR. A low-power Doppler radar was installed at Dulles Airport as part of a wind shear warning system.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

**4.0006, HIGH THROUGH-FLOW TURBOFAN COMPRESSOR DEVELOPMENT**
*N.T. MONSARRAT*, United Aircraft Corporation, *Hartford, Connecticut* 06118 (DN596802; N00140-73-C-0683)

Design and fabricate and test an advanced technology high through- flow compressor for future aircraft gas turbine engines. High through- flow means that the axial Mach number throughout the compressor is higher than current production machinery, thus increasing the pressure rise capability for a given number of compressor stages. It is this increased pressure capability which affords a dramatic saving in compressor stages for a given overall pressure ratio.

Conduct an aerodynamic design of an advanced technology five-stage 6.1 pressure ratio high through-flow compressor application in the high spool of a turbofan. Perform vane and blade flutter and stress calculations plus stress analysis of disk and case structures. Complete a mechanical design of compressor disks, blades and stators, based on aerodynamic structural design. Conduct an aerodynamic design of an advanced technology six-stage 11.5:1 pressure ratio high through-flow compressor for application as a single spool turbojet. Perform stability audit. Fabricate one set plus appropriate spares of compressor hardware consisting of disks, blades and stators for turbofan application. Assemble the compressor turbofan core hardware. Conduct approximately 20 hours of sea level test of turbofan compressor hardware.

ADDENDA: Supporting agency address is: Naval Air Propulsion Test Center Research and Technology Group (PE4), Trenton, N.J.08628

SUPPORTED BY U.S. Dept. of Defense - Navy

**4.0007, THE INTERACTION BETWEEN FLOW DISTURBANCES AND AN AIRFOIL WITH SPECIAL EMPHASIS ON THE UNSTEADY KUTTA CONDITION**
*C. TAM*, State University of Fla. Sys., School of Arts & Sciences, *Tallahassee, Florida* 32306 (NSG 2201)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**4.0008, DIGITAL SIMULATION OF DYNAMIC STABILITY AND RANDOM PARALLELING OF ERDA-NASA WIND TURBINE GENERATORS WITH SMALL POWER SYSTEMS**
*H.H. HWANG*, Univ. of Hawaii, School of Engineering, *Honolulu, Hawaii* 96822 (NSG 3132)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**4.0009, A JOINT PROJECT FOR STUDY OF CYLINDRICAL FRESNEL LENS AS A SOLAR CONCENTRATOR**
*R.M. COSBY*, Ball State University, School of Hum. & Sciences, *Muncie, Indiana* 47306 (NCA 8-127)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**4.0010, CAREER DEVELOPMENT RESEARCH ACTIVITIES - IMAGE INTENSIFIER RESEARCH**
*R.A. KASSANDER*, Univ. of Maryland, Graduate School, *College Park, Maryland* 20740 (NCA 5-18)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**4.0011, ANALYSIS OF IMAGERY AND CALIBRATION CAMERAS**
*A. ROSENFELD*, Univ. of Maryland, School of Engineering, *College Park, Maryland* 20740 (NCA 5-17)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**4.0012, STUDY OF FEASIBILITY OF APPLYING SUPERCONDUCTING COIL TECHNOLOGY TO GENERAL-PURPOSE MAGNETIC BALANCE AND SUSPENSION SYSTEM**
*E.E. COVERT*, Mass. Inst. of Technology, School of Engineering, *Cambridge, Massachusetts* 02139 (NSG 1356)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**4.0013, PREPARATION AND CHARACTERIZATION OF GALLIUM ARSENIDE SOLAR CELLS**
*H.C. GATOS*, Mass. Inst. of Technology, School of Engineering, *Cambridge, Massachusetts* 02139 (ENG76-22310)

An electric current-controlled liquid phase epitaxial technique has been shown to be effective in the preparation of gallium arsenide films of precise thickness and dopant concentration profile. The investigation of the properties of these films will continue with emphasis on the electrical characteristics of p-n junctions and their relation to such materials parameters as compositional homogeneity and defect structure. The role of surface preparation and ambients on surface state structure and recombination velocity will also be investigated. It is expected that improvement in surface properties can be achieved and that photovoltaic cell efficiency can be increased.

This is a continuation of research previously supported under NSF grant ENG-7409610.

SUPPORTED BY U.S. Natl. Science Foundation

**4.0014, RETARDING ION MASS SPECTROMETER ON THE HIGH-ALTITUDE ELECTRODYNAMIC EXPLORER**
*G.R. CARIGNAN*, Univ. of Michigan, School of Engineering, *Ann Arbor, Michigan* 48106 (NAS 8-32332)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**4.0015, DEVELOP AND DELIVER ENGINEERING MODEL OF FABRY-PEROT INTERFEROMETER**
*UNKNOWN*, Univ. of Michigan, Graduate School, *Ann Arbor, Michigan* 48104 (NAS 5-23791)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**4.0016, TRANSONIC FLOW AROUND WINGS, BODIES AND WING-BODY CONFIGURATIONS**
*E.H. DOWELL*, Princeton University, School of Engin. & Appl. Sci., *Princeton, New Jersey* 08540 (NSG 2194)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**4.0017, RESEARCH OF INSTRUMENTATION DESIGN PARAMETERS FOR SOLAR X-RAY POLARIZATION EXPERIMENTS**
*R. NOVICK*, Columbia University, School of Arts & Sciences, *New York, New York* 10027 (NSG 5146)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**4.0018, INVESTIGATION OF FLOW NOISE FROM STREAMLINED AND BLUNT BODIES - TRAILING EDGE EFFECTS**
*T.H. HODGSON*, Univ. of North Carolina, School of Engineering, *Raleigh, North Carolina* 27607 (NSG 1377)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**4.0019, CHARGE TRANSFER DEVICES FOR REMOTE SENSING APPLICATIONS**
*W.E. SNYDER*, Univ. of North Carolina, Graduate School, *Raleigh, North Carolina* 27607 (NSG 1353)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**4.0020, HIGH-SPEED COMPUTER-CONTROLLED VOR RECEIVER DETECTOR**
*R.W. LILLEY*, Ohio University, Graduate School, *Athens, Ohio* 45701 (NAS 2-9431)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**4.0021, ADAPTATION OF ION BEAM TECHNOLOGY TO MICROFABRICATION OF SOLID-STATE DEVICES AND TRANSDUCERS**
*J.A. TOPICH*, Case Western Reserve Univ., Graduate School, *Cleveland, Ohio* 44106 (NSG 3131)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**4.0022, SLOTTED WALL INTERFERENCE IN SUBSONIC WIND TUNNELS USING NON-HOMOGENEOUS WALL BOUNDARY CONDITIONS**
*E.R. PEJACK*, Youngstown State University, School of Engineering, *Youngstown, Ohio* 44505 (NCA 2-890701)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**4.0023, ADVANCED V/STOL AERODYNAMIC CONCEPTS**
*C.J. MAZZA*, U.S. Navy, Air Development Center, *Warminster, Pennsylvania* 18974 (DN481077)

To conduct research in promising areas of advanced aerodynamics, i.e., technologically efficient areas of unique interest to the U.S. Navy.

Through continuing review of the aerodynamics S.O.A. identify areas of significant technological deficiency and establish priorities based upon Navy unique requirements, impact on operational effectiveness, economy of development and solution risk. Seek qualified sources to perform the work, administer study contracts and provide in-depth technical monitoring and overall program management.

ADDENDA: Supporting agency address is: Naval Air Systems Command (320D), Washington, D.C. 20361

SUPPORTED BY U.S. Dept. of Defense - Navy

**4.0024, LOW-COST AVIONICS FOR THE GLOBAL POSITIONING SYSTEM**
*J.H. PAINTER*, Texas A & M University System, Graduate School, *College Station, Texas* 77843 (NSG 1374)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**4.0025, STUDY ON LOW-ALTITUDE PLASMA INSTRUMENT TO BE FLOWN ON THE ELECTRODYNAMICS EXPLORER**
*J.D. WINNINGHAM*, Univ. of Texas, Graduate School, *Dallas, Texas* 75230 (NAS 5-23804)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**4.0026, EXPERIMENTS ON THE STABILITY AND TRANSITION OF TWO-DIMENSIONAL AND THREE-DIMENSIONAL BOUNDARY LAYERS WITH SUCTION**
*W.S. SARIC*, Virginia Poly. Inst. & St. U., Graduate School, *Blacksburg, Virginia* 24061 (NSG 1358)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**4.0027, DYNAMIC CHARACTERISTICS OF ROTOR BLADES WITH PENDULUM ABSORBERS**
*G.L. GOGLIA*, Old Dominion University, School of Engineering, *Norfolk, Virginia* 23508 (NSG 1370)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**4.0028, EXPERIMENTAL AND ANALYTICAL STUDIES OF SEPARATED VORTEX FLOW ON HIGHLY SWEPT WINGS**
*J.M. KUHLMAN*, Old Dominion University, Graduate School, *Norfolk, Virginia* 23508 (NSG 1357)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**4.0029, INVESTIGATION OF EFFICIENT METHODS FOR OCULOMETER SYSTEM SIGNAL PROCESSING**
*M.R. VARANASI*, Old Dominion University, Graduate School, *Norfolk, Virginia* 23508 (NSG 1379)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

## GEOSCIENCES

Includes Geosciences (general); Earth Resources; Energy Production and Conversion; Environment Pollution; Geophysics; Meteorology and Climatology; and Oceanography. For Related Information See Also Space Sciences.

**5.0001, DEVELOPMENT OF ALABAMA RESOURCES INFORMATION MANAGEMENT SYSTEM**
*R.I. VACBON*, Auburn University, Graduate School, *Auburn, Alabama* 36830 (NAS 3-32215)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**5.0002, MAGNETIC OBSERVATORIES FOR THE INTERNATIONAL MAGNETOSPHERIC STUDY**
*R.L. MCPHERRON*, Univ. of California, School of Letters & Science, *Los Angeles, California* 90024 (ATM76-17035)

During the International Magnetospheric Study (IMS) the University of California at Los Angeles (UCLA) will install four magnetic observatories at remote locations in the Pacific and Atlantic Oceans. The observatories will be entirely automatic, communicating with the U.S. through synchronous meteorological satellites. The observatories will include a magnetometer, data formatter and a data collection platform radio set. These observatories will fill gaps in the existing chain of mid-latitude observatories spanning North America. The entire chain will provide correlative data to be used throughout the world in studies of ultra-low-frequency waves, magnetospheric substorms and magnetic storms. At UCLA the data will be used to supplement magnetic field observations which will be made during the IMS by UCLA experiments on the spacecraft ATS-6 (Applications Technology Satellite) and ISEE A/B (Mother/Daughter) (International Sun Earth Explorer). The ground measurements are important in the interpretation of both satellite and ground data, helping to define the time and location within the magnetosphere of substorms and storms. Magnetospheric substorms have recently been recognized as the cause of auroral disturbances in polar regions. These disturbances are important because they are known to be the

cause of failures in synchronous communication satellites, electrical distribution systems, and telephone networks. They also cause disruptions of polar radio communications, spurious radar returns, and are a serious problem in mineral exploration and navigation.

SUPPORTED BY U.S. Natl. Science Foundation

**5.0003, ATS-6 ENVIRONMENTAL MEASUREMENTS EXPERIMENT DATA REDUCTION AND ANALYSIS**
*R.L. MCPHERSON*, Univ. of California, School of Letters & Science, *Los Angeles, California* 90024 (NAS 5-23702)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**5.0004, CHATANIKA INCOHERENT-SCATTER FACILITY OPERATION AND COORDINATION**
*M.J. BARON*, Stanford Research Institute, *Menlo Park, California* 94025 (ATM72-01644 A05)

This grant funds the operation of the Chatanika Incoherent-Scatter Radar facility in Alaska for research into the quiet and disturbed auroral-zone atmosphere and ionosphere by the U.S. scientific community. Scientific questions to be explored include: 1. electron and ion densities and temperatures during quiet times and during times of auroral electron and proton bombardment, 2. behavior of the auroral-zone ionosphere during times of solar proton events, 3. winds and dynamical effects in the E- and F-regions, 4. relationships of observed phenomena in the auroral-zone ionosphere to geomagnetic variations, visible and infrared light emissions, and gravity and infrasonic wave activity.

SUPPORTED BY U.S. Natl. Science Foundation

**5.0005, STUDY OF TECHNIQUES FOR REPRESENTING SUB-GRID SCALE PHENOMENA IN STRATOSPHERIC CIRCULATION MODELS**
*J.R. SPREITER*, Stanford University, School of Engineering, *Palo Alto, California* 94305 (NCA 2-745704)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**5.0006, MULTIBAND AERIAL REMOTE SENSING FOR MATERIALS IDENTIFICATION**
*M.L. MCCAULEY*, State Transp. Laboratory, *Sacramento, California* 95819 (108927 (HRB NO.))

Aerial remote sensing data will be evaluated for use in identifying materials on the earth's surface. The data will include color, black and white, and infrared photography as well as multiband line scan imagery. Interpretations will be made by standard photointerpretation techniques and by computer analysis using both digital and analog techniques. Detailed geologic mapping will provide the basis for evaluating the various methods.

ADDENDA: Document provided to S.S.I.E. by the H.R.I.S. This project is also supported by: California Department of Transportation.

SUPPORTED BY U.S. Dept. of Transportation - F.H.A.

**5.0007, REMOTE SENSING APPLICATIONS AT HYDROLOGIC MODELING**
*UNKNOWN*, Univ. of California, Graduate School, *Santa Barbara, California* 93106 (NSG 5155)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**5.0008, ATMOSPHERIC SCATTER STUDIES**
*B.B. BALSLEY*, U.S. Dept. of Commerce, Environmental Research Labs., *Boulder, Colorado* 80302 (8DJ4 28 53)

PROJECT OBJECTIVE: To investigate various parameters of the atmosphere/ionosphere system that can be examined by radar techniques.

CURRENT YEAR PLAN: Typical investigations include studies of neutral winds in the height range 10-100 km and ionospheric effects due to underlying orographic features (e.g., mountain lee waves). These studies will incorporate state-of-the-art radar techniques involving portable systems and minicomputers for on-line spectral analysis.

PROGRESS REPORT: Analysis of equatorial neutral wind and temperature data in equatorial regions at heights greater than 100 km show pronounced effects due almost certainly to the Andean Cordillera. This result implies that the entire stratosphere-mesosphere system can be strongly affected by underlying features (mountain ranges, large- scale weather systems, etc.).

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

**5.0009, ATMOSPHERIC AEROSOLS**
*P. CHYLEK*, U.S. Dept. of Commerce, Environmental Research Labs., *Boulder, Colorado* 80302 (8AA711 77)

PROJECT OBJECTIVE: Theoretical investigation of the effect of nonspherical aerosal particles on the interpretation of remote sensing data.

CURRENT YEAR PLAN: Investigate the effect of nonsphericity of aerosol particles on a) polarization of the scattered radiation and propose a remote sensing technique for detecting the nonsphericity of particles, if possible, and b) the differential scattering cross section especially at large scattering angles and its influence on interpretation of remote sensing data.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

**5.0010, MICROWAVE RADIOMETRY**
*M.T. DECKER*, U.S. Dept. of Commerce, Environmental Research Labs., *Boulder, Colorado* 80302 (8AA7 17 41)

PROJECT OBJECTIVE: Theoretical and experimental study of microwave emission, absorption, and scattering by atmospheric constituents to determine the usefulness of radiometry for remote sensing and atmospheric science purposes.

CURRENT YEAR PLAN: Develop radiometric techniques for deriving liquid content of clouds and other cloud parameters; evaluate cloud effects on radiometric remote sensing of other atmospheric prperties; continue work on application of inversion techniques.

PROGRESS REPORT: Developed and applied to experimental data methods for obtaining atmospheric water content and for correcting for the effects of clouds on temperature profile measurements.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

**5.0011, ADVANCED TECHNIQUES**
*R.J. DOVIAK*, U.S. Dept. of Commerce, Environmental Research Labs., *Boulder, Colorado* 80302 (8C370403)

PROJECT OBJECTIVE: To develop suitable Doppler radar and other mesoscale observational equipment and to use it to produce improved descriptions of severe storm circulations. To develop Doppler radar techniques toward the eventual implementation of Doppler radar as an operational radar suitable for application in NWS.

CURRENT YEAR PLAN: On-line pulse-pair processors will be modified to permit increased data acquisition rate. Electronic circuitry will be added to provide for more flexible data acquisition schemes.

The pulse-Doppler radars will be configured to allow sensitivity necessary to detect clear air motions. Dual Doppler data in pre-storm environments as well as in the cumulus stage of thunderstorm development will be acquired for subsequent synthesis and analysis.

High-PRF data, acquired within a tornadic storm during Spring 1976, will be analyzed to derive maximum wind fields and tornado characteristics. Further high-PRF data will be collected whenever a tornadic storm is within Doppler range.

We anticipate having an observational program using WPL's VHF lightning location equipment during Spring '77. Comparison of lightning structure with resolution comparable to radar is expected and correlation of lightning properties with thermodynamic ones will begin.

Further development of real-time displays to aid data acquisition, particularly high-PRF data, will be done. Real-time

data transfer from the Cimarron Doppler will aid tornadic data acquisition during high-PRF operation.

Modifications will be made to the Norman Doppler to sort range ambiguous echoes and have storms displayed unambiguously on a color refresh monitor. A ground clutter filter will be designed, fabricated and tested. This filter will minimize ground clutter bias in pulse-pair estimates of meteorological target velocities.

PROGRESS REPORT: Pulse-pair processors were brought on line at the Norman and Cimarron Doppler radars. These processors provide real-time estimates of Doppler velocity and spectrum width simultaneously at 762, 150 m range locations. Data acquistion and density within storms are increased manyfold.

A minicomputer system was interfaced with the Cimarron Doppler radar providing real-time data monitoring and diagnostics of the digital hardware at this remote facility. (Text Abridged.)

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

**5.0012, DATA ACQUISITION**

*C.E. HORNBACK*, U.S. Dept. of Commerce, Environmental Research Labs., *Boulder, Colorado* 80302 (8DJ2 29 60)

The Real-Time Data Service provides data collection and research facilities at Table Mountain, Colorado, and Anchorage, Alaska, for monitoring satellite and ground-based geophysical sensors. The data are used to support the Space Environment Services of SEL and the AF AWS.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

**5.0013, CUMULUS MODIFICATION**

*W.L. WOODLEY*, U.S. Dept. of Commerce, Environmental Research Labs., *Boulder, Colorado* 80302 (8G141111)

PROJECT OBJECTIVE: The research in Cumulus Modification has at its primary objective an assessment of the physical basis and the evaluation of the effects of multiple cumulus 'dynamic' seeding over an area of the south Florida peninsula, with a view towards assessing the potential of the technique for enhancing precipitation in Florida and other regions under the influence of tropical air masses. A necessary corollary goal is an increased understanding of the dynamics and microphysics of convective cloud processes and the natural variability of precipitation resulting from such processes.

CURRENT YEAR PLAN: Evaluation of observations made during the Florida Area Cumulus Experiment (FACE) of 1976 will be the main objective of FY77. The randomized seeding aspect of this program will receive special emphasis so that results will be obtained by December 1976 to permit intelligent planning for the future. Merger Task Force studies will be continued and expanded in the coming year. Analysis of cloud physics and sferics observations obtained in FACE 1976 will also be emphasized. A continuation of the FACE field effort during the summer of 1977 is possible.

PROGRESS REPORT: Results of randomized studies in FACE for the period 1970-1975 were obtained with strong indications that dynamic seeding alters the rainfall depending on whether the days of experimentation are motion or no-motion days. The ambitious FACE 1976 summer field effort was completed with the addition of 27 days of experimentation. Progress was also made during the year in specifying the internal structures of supercooled Florida cumuli and in adapting the Cumulus Group method to estimate rainfall from satellite imagery to the computer.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

**5.0014, RESEARCH OF OBSERVED AND THEORETICAL VARIATIONS OF ATMOSPHERIC OZONE**

*J. LONDON*, Univ. of Colorado, School of Arts & Sciences, *Boulder, Colorado* 80302 (NSG 5153)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**5.0015, MICROWAVE SENSING OF SNOWCOVER WETNESS**

*UNKNOWN*, George Washington University, Graduate School, *Washington, District of Columbia* 20006 (NAS 5-23809)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**5.0016, PERTURBATIONS TO ATMOSPHERIC METHANE - THEIR CAUSES AND POSSIBLE EFFECTS**

*W.L. CHAMEIDES*, State University of Fla. Sys., Graduate School, *Gainesville, Florida* 32601 (NSG 1363)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**5.0017, PHYSIOGRAPHIC CLASSIFICATION OF SOUTHERN PINE FOREST LANDS**

*J.T. MAY*, Univ. of Georgia, Agric. Experiment Station, *Athens, Georgia* 30601 (0060780; GEO-0025-MS)

OBJECTIVE: Organize physiographic land patterns into a system having significance and utility for resource managers. Develop a physiographic map of southern region using the new system.

APPROACH: Current information on physiography, soils, and surface geology related to forest vegetation will be analyzed and coordinated. Localized information will be reorganized to form a unified regional system. Map development will be on a State basis, utilizing local authorities, aerial photography, and space imagery when appropriate.

PROGRESS: A physiographic map (scale 1:500,000) delineating the major subdivisions of the State of Georgia was completed. Subdivisions were based on ERTS imagery, published soil and geologic maps, earlier physiographic work and local knowledge of personnel at the University of Georgia. This map has been forwarded to Auburn University for incorporation into the regional map and eventual publication.

SUPPORTED BY U.S. Dept. of Agriculture - C.S.R.S.

**5.0018, ATMOSPHERIC CHEMISTRY - MECHANISMS AND KINETICS OF THE REACTIONS OF OZONE AND STRATOSPHERIC POLLUTANTS**

*J.N. GAYLES*, Morehouse College, Graduate School, *Atlanta, Georgia* 30314 (NSG 7269)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**5.0019, STRUCTURE OF THE PLANETARY BOUNDARY LAYER**

*B. ACKERMAN*, Univ. of Illinois, State Water Survey Division, *Urbana, Illinois* 61802 (ATM76-15870)

The planetary boundary layer (PBL) is the region of the atmosphere through which major energy transfers between the atmosphere and the earth's surface occur. The PBL structure is very complex, largely because of the generally turbulent nature of the flow. Very little is known about the structure of the PBL, except perhaps in the lowest few tens of meters, because of the difficulty in making adequate measurements.

The objective of this research is to carry out a study of the structure of the PBL over a 2000 square-mile 'meso-region'. It is to be based on an existing data set which includes aircraft measurements of the mean and turbulent components of wind, temperature and moisture, plus vertical profiles of these parameters obtained with balloons and helicopters.

This research seeks to add to our understanding of the boundary layer processes by identification of the dominant mean and turbulent properties of the thermal and kinematic structure of the PBL over surfaces of different physio-thermal characteristics. Part of the study will be dedicated to providing documentation that will be useful in the development of diagnostic and predictive models.

SUPPORTED BY U.S. Natl. Science Foundation

**5.0020, MICROWAVE REMOTE SENSING OF SNOW**
*F.T. ULABY*, Univ. of Kansas, School of Engineering, *Lawrence, Kansas* 66044 (NAS 5-23777)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**5.0021, PHYSIOGRAPHIC CLASSIFICATION OF SOUTHERN PINE FOREST LANDS**
*R.F. WITTWER*, Univ. of Kentucky, Agric. Experiment Station, *Lexington, Kentucky* 40506 (0060663; KY00605)

OBJECTIVE: Organize physiographic land patterns into a system having significance and utility for resource managers. Develop a physiographic map of southern region using the new system.

APPROACH: Current information on physiography, soils, and surface geology related to forest vegetation will be analyzed and coordinated. Localized information will be reorganized to form a unified regional system. Map development will be on a State basis, utilizing authorities, aerial photography, and space imagery when appropriate.

PROGRESS: Additional printed matter containing information on the soils and geology of Kentucky has been collected. Plans were formulated for a visit, in early 1976, by a representative of the Project Leader for the purpose of establishing guidelines and procedures in order to initiate mapping of forest habitat regions in Kentucky using satellite imagery at a scale of 1:500,000.

SUPPORTED BY U.S. Dept. of Agriculture - C.S.R.S.

**5.0022, WORLD GEOID BY DENSITY LAYER METHOD**
*B. CHOVITZ*, U.S. Dept. of Commerce, Geodetic Res. & Dev. Lab., *Rockville, Maryland* 20852 (836910B0)

The determination of the Earth's gravitational field is being attempted by this laboratory by employing the density layer method, in which the anomalous potential is considered as being condensed into a simple layer of varying density over the surface of the reference figure. This approach has the advantage of easier geographic and geophysical correlation with physical reality than the spherical harmonic representation, is simpler computationally than the gravity anomaly representation, and is capable of generalization and deeper analysis because it is directly tied in with the basic boundary value problem of geodesy.

Technical objective is to improve description of the figure of the Earth and its gravity field, to apply this technique to other planetary bodies, and to conduct geophysical correlation studies in order to identify structural and density variations in the Earth's crust and mantle.

Although the density layer method conceptually involves a layer of continuously varying density over the Earth's surface, in practice, computation and evaluation must be carried out by discrete methods, that is, breaking the surface up into blocks, over each of which the layer is either constant or follows a law holding for that particular block. Various methods will be tried, both analytical and numerical, in order to obtain the best possible accuracy for the most efficient computer time. Since computer time can be extremely large in these computations, a large part of the effort will go into optimizing programs.

Data sources employed up to now have been satellite optical and Doppler observations, and ground gravimetry. As new data sources open up, like altimetry, these will be introduced into the analysis. The geophysical correlation studies will be based on both statistical methods, and on physical model building. Relations between the density layer and other representations have been developed in order to readily transform from one system to the other, depending on the type of data at hand and the mode of presentation desired.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

**5.0023, DYNAMIC METEOROLOGY**
*R.S. LINDZEN*, Harvard University, School of Arts & Sciences, *Cambridge, Massachusetts* 02138 (ATM75-20156 A01)

This grant is to support research covering a wide range of topics in atmospheric dynamics. Although many atmospheric phenomena appear very different upon preliminary observation, the essentials of wave motion, unstable flows, convection, latent heat release, etc., are always the same and always present albeit in varying proportions. The following specific topics will be examined in the following areas: I. Tropical meteorology: a) The parameterization of cumulus convection; b) The interaction of internal waves with cumulus convection; c) The role of mean vertical shear in tropical waves; d) Hurricane development. II. Mesoscale meteorology: a) Waves on inversion surfaces; b) Instabilities of shear zones and clear air turbulence. III. Stationary large-scale waves: a) Resonance, sudden warmings and blocking; b) Forcing of the mesospheric semiannual oscillation by seasonal variations in the stationary waves; c) The origin of polar fronts. IV. Upper atmospheric dynamics: a) Ionspheric dynamic theory; b) Improved tidal calculations. V. Climatology: a) Zonally symmetric Hadley circulations; b) Monsoon model; c) Simple dynamic climate models.

SUPPORTED BY U.S. Natl. Science Foundation

**5.0024, STRATOSPHERIC TRANSPORT PROCESSES AND THE INTERPRETATION OF DATA ON MINOR CONSTITUENTS**
*F. ALYEA*, Mass. Inst. of Technology, School of Science, *Cambridge, Massachusetts* 02139 (NSG 2196)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**5.0025, PULSE PAIR PROCESSING TECHNIQUES FOR IDENTIFICATION OF SEVERE STORMS**
*UNKNOWN*, Environmental Res. & Tec. Inc., *Concord, Massachusetts* 01742 (DF246910; F19628-76-C-0264)

AF function - protection of aerospace systems in severe storms. Deficiency - identification and warning of storm hazards by current methods are unreliable. Development - develop radar techniques for diagnosis of storms and attendant precipitation and wind fields. How development contributes - provides improved identification and prediction of convective storm hazards. Measurements of shear anomalies and reflectivity structure provide data for identification of severe convective storms and for study of storm organization and trend as revealed by interaction of fields of motion and precipitation.

ADDENDA: Supporting agency address is: AF Geophysics Laboratory LY, L.G.Hanscom AFB, Bedford, Mass 01730

SUPPORTED BY U.S. Dept. of Defense - Air Force

**5.0026, DEVELOPMENT OF TECHNIQUES IN FOREST BIOMETRY**
*W.L. MYERS*, Michigan State University, Agric. Experiment Station, *East Lansing, Michigan* 48823 (0063482; MICL01148)

OBJECTIVE: Develop biometrical computer software that emphasizes ease of application. Determine design parameters for sampling Michigan forest resources. Design and test improved methods of forest measurement. Expand technical capabilities for measuring non-timber values of forests.

APPROACH: Computer software development entails extensive systems analysis and programming to adapt existing theory to practical needs. Data bank on statistical characteristics of forest resources requires field sampling, assembling available data, and development of retrieval system. Improved mensurational methods require development and modification of both instrumentation and inventory systems. Exploration of economical parameters to be measured is the most pressing need in measurement of non-timber values.

PROGRESS: One component of this project deals with applications of remote sensing in forestry. A set of our forest resource maps covering Mason Co., Michigan, has been prepared from small- and medium-scale color infrared aerial photography. The maps provide in-place information on timber types, stocking, and maturity. These maps have been well received by timber interests in Mason Co. The maps are complete and ready for distribution, but documentation of the work is still in press. A study of potential applications of SKYLAB imagery in forest mapping has also been conducted, with partial documentation in the form of an in-

ternal report. Research into the use of small camera aerial photography from light planes for applications in urban forestry is continuing. All of these remote sensing studies involve cooperation and support from NASA. A second component of the project involves development of forest inventory systems. Under this component, a review of inventory systems for timber management used by the U. S. Forest Service in Region 6 has been completed. The results of this review indicated the need for introducing more flexibility to the use of the systematic grid and more emphasis on stand exam surveys to support silvicultural diagnosis and prescription. A third component of the project is to develop biometrical computer software. Work on a multivariate analysis package has been started, and completed programs for information handling, graphics, and least squares need to be documented.

SUPPORTED BY U.S. Dept. of Agriculture - C.S.R.S.

**5.0027, DETECTION OF LEAF BLIGHT OF CORN BY REMOTE SENSING**

*G.R. SAFIR*, Michigan State University, Agric. Experiment Station, *East Lansing, Michigan* 48823 (0059700; MICL01077)

OBJECTIVE: Determine if, by remote sensing, it is possible to detect early stages of infection by Helminthosporium maydis, distinguish disease produced by H. maydis from disease produced by other organisms, and detect differences in resistance between different lines of corn or in segregating populations.

APPROACH: Many different lines of corn will be grown in the greenhouse and inoculated with H. maydis, H. turcicum, Kabatiella zeae, and Phyllosticta sp. and examined daily with remote sensing equipment. The effect of inoculation methods, resistance, and date after inoculation on the remote sensing data obtained will be determined. Similar experiments will be also performed under field conditions.

PROGRESS: Aerial infrared (IR) photography was used for the detection of blackroot disease of sugarbeets in the field. High correlations were obtained between photo estimates of foliage quantity and preharvest visual (ground) estimates of foliage vigor and quantity. At the time aerial photographs were taken, the reflectance characteristics of leaves from infected plants were similar to those from uninfected plants. This indicated that aerial photographic ratings should indicate differences in foliage quantity. One use of aerial IR photography for the detection of Rhyactonia root rot of sugarbeet was attempted and the data are being analyzed. A study to determine the utility of IR aerial photography for the detection of Wheat Spindle Streak Mosaic disease was initiated using 150 wheat line in the field.

SUPPORTED BY U.S. Dept. of Agriculture - C.S.R.S.

**5.0028, ENERGETICS AND CLIMATOLOGY OF THE ATMOSPHERIC GENERAL CIRCULATION**

*E.C. KUNG*, Univ. of Missouri, Agric. Experiment Station, *Columbia, Missouri* 65201 (0057259; MO-00310)

OBJECTIVE: Complex energy transformations of various scales of motion and thermodynamic processes will be studied. Information obtained is to be incorporated in various numerical models of weather and climatic forecasting. Examination of long-range variation of energetics parameters will provide basic information in formulating parametric models of meso-range climatic forecasting. These researches are integral parts of the Global Atmospheric Research Program.

APPROACH: Energy transformation in middle-lattitudes, generation of wave disturbances, subsynoptic scale processes, tropical energy balance, climatological variation of energy parameters and their temporal and spacial coherence will be computed with avialable upper-air and satellite data.

PROGRESS: The diagnosis of energy transformations in the middle- latitude transient disturbances reveals characteristic roles of cyclones, anticyclones and intermediate disturbances in maintenance of the atmospheric circulation. The kinetic energy balance of the tropical circulation described origin and maintenance of tropical waves and their basic flow. The subsynoptic scale energetics analysis was able to account for the energy flow between the large and meso scale phenomena. Presently the energetics analysis of the Atlantic Tropical Experiment and the Airmass Transformation Experiment, and studies of climatological forecasting techniques are in progress.

SUPPORTED BY U.S. Dept. of Agriculture - C.S.R.S.

**5.0029, PERFORM PRELIMINARY EXPERIMENTS TO EVALUATE PARTICLE GENERATION AND CHARACTERIZATION TECHNIQUES FOR ZERO GRAVITY CLOUD PHYSICS EXPERIMENTS**

*W.C. KOCMOND*, Univ. of Nevada System, Graduate School, *Reno, Nevada* 89507 (NAS 8-32313)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**5.0030, INVESTIGATION OF VOLCANIC GASES AND DUST (AEROSOLS) IN THE STRATOSPHERE**

*R.W. DECKER*, Dartmouth College, School of Arts & Sciences, *Hanover, New Hampshire* 03755 (NSG 5145)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**5.0031, MAGNETOPAUSE - STRUCTURE FROM SATELLITE OBSERVATIONS**

*B. SONNERUP*, Dartmouth College, School of Engineering, *Hanover, New Hampshire* 03755 (NSG 7292)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**5.0032, ATMOSPHERIC INFLUENCES OF ECOSYSTEMS AND SATELLITE SENSING**

*A.V. HAVENS*, Rutgers the State University, Agric. Experiment Station, *New Brunswick, New Jersey* 08903 (0057736; NJ00282)

OBJECTIVE: Analyze weather data from surface and satellite observations to aid in planning for remote sensing operations by Earth Resources Technology Satellite (ERTS) and aircraft; evaluate environmental effects by use of a chemical reaction temperature integrator and an inter-regional phenological network and develop improved statistical relationships and analyses of solar radiation and certain other atmospheric variables of fundamental impact on plant growth and yield.

APPROACH: Relate ground observations of cloud cover to cloud cover data from ESSA and NIMBUS meteorological satellites. Interpret the results in terms of the effect of cloudiness on ERTS observations. Participation in the phenological network begun under the NE-35 project will be continued and enlarged. Inter-regional cooperation is expected. Measurements of solar radiation are continuing. The relationships between solar radiation and other weather elements of significance to agriculture will be studied.

PROGRESS: Measurement of daily solar radiation and related meteorological data at the New Jersey Agricultural Experiment Station was continued. Operation and maintenance of a network of 25 phenological observation stations in New Jersey was continued. Work on the development and testing of various methods for predicting phenological phases in lilac (cultivar 'Red Rothomagensis') was concluded. The results showed that Photo-Thermal Units were more accurate than any of the other methods tested for predicting first bloom and full bloom. Prediction accuracy averaged plus or minus 2 days. These results were presented in detail in a thesis entitled 'The Selection & Application of a Phenological Model for Lilac Cultivar 'Red Rothomagensis'.'

SUPPORTED BY U.S. Dept. of Agriculture - C.S.R.S.

**5.0033, THE PHYSICAL AND METEOROLOGICAL CHARACTERISTICS ASSOCIATED WITH THE LIGHTNING DISCHARGE**

*R.E. ORVILLE*, State University of New York, School of Arts & Sciences, *Albany, New York* 12222 (ATM75-20155 A01)

This research concerns the physical characteristics of the lightning discharge. Studies will include: correlation of recent measurements of return stroke velocities with simultaneous measurements of the electric field from the same stroke; luminosity characteristics from a section of the return stroke channel and the extent the light variations follow the electric field variations, and

by inference, the electric current; measurement of the dart length in the dart leader; the characteristics of lightning detected by the Defense Meteorological Satellite Program to determine the feasibility of estimating lightning - flash frequencies and densities; possible extension of these analyses to remote severe storm indices and to an estimate of the worldwide nighttime thunderstorm activity; and the nature of the lightning discharge and the associated meteorological conditions by a study of these records from 1959-1972 at the Swiss Institute of Technology and at the Locarno Meteorological Observatory, Switzerland.

SUPPORTED BY U.S. Natl. Science Foundation

**5.0034, NAVY ENVIRONMENT - SEASAT-A DATA USER APPLICATIONS**
*P.G. NEUMANN*, City University of New York, Graduate School, *New York, New York* 10031 (DN475131; N00014-76-C-0374)

The Navy needs accurate forecasts of atmospheric weather conditions at sea for predicting the growth of ocean waves (as applied to optimum- track ship routing) and the development of the mixed layer (as applied to surface direct acoustic propagation in ASW). In order to increase its capability to produce such atmospheric forecasts, the navy needs to develop procedures to process the oceanographic and meteorological data from future satellites for use in its operational numerical weather prediction models. The objective of this task is to process the data from the SEASAT-A satellite.

Computer programs will be developed to process suface wind velocities, surface barometric pressures, sea-surface temperatures, and rainfall so that the data can be combined to produce an improved initial value specification for the operational models.

ADDENDA: Supporting agency address is: Office of Naval Research 481, Arlington, VA. 22217

SUPPORTED BY U.S. Dept. of Defense - Navy

**5.0035, STRUCTURE, GROWTH AND TREE MORTALITY IN MIXED FOREST STANDS IN PENNSYLVANIA**
*R.E. MELTON*, Penn. State University, Agric. Experiment Station, *University Park, Pennsylvania* 16802 (0061099; PEN02025)

OBJECTIVE: Identify and classify stand structures, growth rates, and tree mortality in forest stands. Evaluate tree mortality in relation to stand factors, environmental factors, and defoliation by gypsy moth, oak leaf tier and oak leaf roller, and develop silvicultural measures for insect control.

APPROACH: Analyze data collected over 23 years in 18 stands of The Stone Valley Experimental Forest, and make one additional inventory in these stands. Determine relationships between growth, mortality, composition, structure, stocking level, and intermediate silvicultural treatments. Establish plots in stands infested or threatened by gypsy moth, oak leaf tier and oak leaf roller to determine characteristics of stands and individual trees susceptible to heavy mortality as a result of defoliation by insects and the usual environmental hazards.

PROGRESS: The effectiveness of LANDSAT-1 satellite multispectral digital data and imagery, supplemented by ground truth and serial photography, for surveying gypsy moth defoliation was investigated. Part of a July 1973, LANDSAT-1 scene showing extensive defoliation in northeastern Pennsylvania was analyzed by computer processing techniques developed at The Pennsylvania State University. Results indicate that LANDSAT-1 data can be used to discriminate between defoliated and healthy vegetation in Pennsylvania and that digital processing methods can be used to map the extent and degree of defoliation. Spectral signatures developed from this scene were used to detect defoliation in central Pennsylvania.

SUPPORTED BY U.S. Dept. of Agriculture - C.S.R.S.

**5.0036, COMPARATIVE SPECTRAL RADIOMETRY OF PRIMARY PRODUCERS IN A SALT MARSH ESTUARY**
*R.G. ZINGMARK*, Univ. of South Carolina, School of Science & Math., *Columbia, South Carolina* 29208 (NSG 1334)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**5.0037, IONOSPHERE-MICROWAVE BEAM INTERACTION STUDY**
*W.E. GORDON*, Rice University, School of Engineering, *Houston, Texas* 77001 (NAS 9-15212)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**5.0038, STUDY OF THE DYNAMICS OF ATMOSPHERE-IONOSPHERE-MAGNETOSPHERE INTERACTIONS**
*UNKNOWN*, Utah State University, Graduate School, *Logan, Utah* 84321 (NSG 7289)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**5.0039, ATMOSPHERIC CIRCULATIONS AND AEROSOL DISPERSION IN MOUNTAINOUS TERRAIN**
*G.L. WOOLDRIDGE*, Utah State University, Agric. Experiment Station, *Logan, Utah* 84321 (0062929; UTA00403)

OBJECTIVE: Refine the numerical valley aerosol dispersion model currently under development. Test the dispersion model through tracer releases and detection. Investigate surface radiative heat exchange as a valley circulation driving force. Integrate results from the model into land use planning programs.

APPROACH: Generate a time-dependent set of aerosol concentrations with a numerical circulation-dispersion model. Release tracer material at near-ground levels and sample with an aircraft and at ground levels throughout Cache Valley to verify the model calculations. Investigate slope and valley wind responses to radiative fluxes at the surface with tower-mounted thermisters and anemometers, and with net radiometers.

PROGRESS: A three-dimensional model of atmospheric dispersion of gaseous and particulate aerosols has been programmed for the Utah State Burroughs computer; the model moves aerosols with measured wind systems and through turbulent fluxes. Sensitivity of this volumetric model and of the standard plume model to the attachment or 'inhalation' of aerosols by plants and trees is being tested numerically. Near-surface aerosol gradient values and diffusion parameters will be drawn from the literature and incorporated into the models to determine the role that plants and/or trees play in acting as 'sinks' for the removal of objectionable aerosols from the atmosphere. This aspect of dispersion forms the basis for an MS thesis for a biometeorology graduate student. Wind data previously gathered in the Eagle River Valley of Colorado and in Cache Valley have been statistically analyzed to determine the manner in which air flow over mountain valleys exhanges momentum with valley circulations below. Calculations have shown that some cases the turbulent momentum exchange near mountain ridge levels accelerates valley air as strongly as does differential heating due to diurnal solar heating cycles. This strongly suggests that this factor must be taken into account when modelling the initiation of valley wind systems, especially for controlled burning of forest lands in mountain valleys. A concentrated field investigation of mountain valley winds and turbulence was performed in the Gore Creek Valley of Colorado.

SUPPORTED BY U.S. Dept. of Agriculture - C.S.R.S.

**5.0040, OPTICAL REMOTE SENSING OF SHALLOW WATER BATHYMETRY**
*D.S. ROSS*, U.S. Dept. of the Interior, Geological Survey, *Herndon, Virginia* 22092 (7-741; 5-15008)

The overall objective of this task was to determine the feasibility of mapping shallow water depths from high altitude (aircraft and/or satellites) using optical imagery.

SUB-OBJECTIVES: (1) Analyze, evaluate and compare multispectral images of coastal areas with bathymetric charts supplied by the USGS and NOAA. (2) Evaluate various visible region spectral bands with regard to depth penetration and atmospheric haze interference in relation to bathymetric (surface truth) charts. (3) Recommend sensor bands for LANDSAT-C for shallow water bathymetric applications.

The approach taken by the investigator was to examine natural color photographs from SKYLAB (S-190 A and B), GEMINI,

and APOLLO spacecraft and multispectral scanner images from LANDSAT and SKYLAB S-192 spacecraft and the NASA/GSFC ocean water color scanner. Some black and white and natural color images from NASA Ames U-2 aircraft were examined.

The sub-objectives were accomplished and the results are contained in a report by Donald S. Ross entitled 'Photographic Imagery and Shallow Seas Bathymetry by Remote Sensing' dated 24 April 1976. The prime objective to demonstrate feasibility of mapping bathymetry from high altitudes was partly accomplished. A series of conclusions and recommendations regarding this objective is contained in the Ross report. One set of images of coastal ocean areas with bathymetric data was applied to NOAA and one to USGS in response to sub-objective (1). The responses to sub-objectives (2) and (3) are contained in the Ross report.

In arriving at the conclusions, recommendations, and results, Mr. Ross records a thorough technical discussion of ocean water and atmospheric physics, bathymetric reference data, test sites, comparison of photographic and photoelectric sensors, sensitometry and quality of LANDSAT and SKYLAB images, spectral bands and their simulation with color films, color separation techniques, color separation results, photographic spectral masking, photographic density slicing, comparisons of LANDSAT, SKYLAB, U-2, and Ocean Color Scanner images, sun elevation and illumination in the water, and considerations in selecting new spectral bands. (Text Abridged.)

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

**5.0041, ANALYSIS OF HALOCARBONS IN ANTARCTICA**
*R.A. RASMUSSEN*, Washington State University, School of Engineering, *Pullman, Washington* 99163 (DPP76-00437 A01)

The objective of this project is to quantify the phenomenon of the occurrence of enriched concentrations of halocarbons and other trace gases in the snow and ice cap at the South Pole. Special attention will be given to chlorofluorocarbon distributions which are believed to be chemically stable in the troposphere and to better understand their processes of removal or accumulation relative to climate change. Measurement and analysis will be accomplished by gas chromatography and mass spectrometry. By establishing an historical record of gaseous constituents in the near-surface snow layers, it may be possible to obtain a better perspective for interpreting the present flux of halocarbons in the earth's atmosphere. The January 1976 field work was limited to collecting air samples and a few snow cores from the Ross Ice Shelf. The major effort for the 1976/77 season will be to collect a sufficient number of both snow-ice and air samples near the ground at South Pole and McMurdo. The secondary effort during this season will be to obtain airborne samples using one of the LC 130 aircraft. Three scientists will conduct this study in Antarctica during the 1976/77 and the 1977/78 austral summers.

SUPPORTED BY U.S. Natl. Science Foundation

**5.0042, EVALUATION OF BLACK BEAR DAMAGE**
*G.F. SCHREUDER*, Univ. of Washington, School of For. Resources, *Seattle, Washington* 98195 (0061482; WNZ-63-1010)

OBJECTIVE: Develop a quantitative expression of bear damage to forest stands in western Washington and develop economic decision criteria to indicate when damage control measures become desirable.

APPROACH: Simulation models will be developed and validated by field data.

PROGRESS: The existing literature on black bear damage is summarized. It provides valuable background information as to the variables that are likely to be important in assessing the damage and for an understanding of the problem. Tree damage by black bears will become of increasing economic significance as the value of immature timber increases and as forest management practices intensify. The impact of bear damage will be particularly significant in stands where optimum stocking levels are achieved at an early age. An economic framework is then developed which provides decision criteria as to whether or not to engage in black bear damage control. It was developed with the objective of providing these criteria in a fast and inexpensive way, not necessarily in the most accurate way. Specifically, the criteria used data obtainable from aerial photographs supported by a minimum of ground work or ground information.

SUPPORTED BY Washington State Government - Olympia

**5.0043, AN ANALYSIS OF PACIFIC NORTHWEST STATE AND LOCAL AGENCIES' OPERATIONAL REQUIREMENTS FOR AN EARTH RESOURCES DATA MANAGEMENT FACILITY**
*F.V. WESTERLUND*, Univ. of Washington, Graduate School, *Seattle, Washington* 98105 (NCA 2-850701)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**5.0044, RESEARCH OF CLOUDS AND ICE IN THE PLANETARY SCALE CIRCULATION AND IN CLIMATE**
*D.D. HOUGHTON*, Univ. of Wisconsin, School of Letters & Science, *Madison, Wisconsin* 53706 (NSG 5152)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

## LIFE SCIENCES

Includes Life Sciences (general); Aerospace Medicine; Behavioral Sciences; Man/system Technology and Life Support; and Planetary Biology.

**6.0001, BLOOD PROTEIN AND RED CELL TURNOVER RATE STUDIES IN MATURE DOGS EXPOSED TO HYPER-G USING THE CONTINUOUS LOW-G ANIMAL CENTRIFUGE**
*J.W. EVANS*, Univ. of California, School of Agric. & Envir. Sci., *Davis, California* 95616 (NCA 2-180701)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**6.0002, BIOCHEMICAL AND STRUCTURAL STUDIES ON THE THERMAL RESISTANCE OF 'HARDY' BACTERIAL SPORES**
*A.J. ANDREOLI*, Calif. State Univ. & Colleges, School of Letters & Science, *Los Angeles, California* 90032 (NSG 2199)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**6.0003, GLUCOCORTICOID EFFECTS ON BONE FORMATION IN VITRO**
*D. FELDMAN*, Stanford University, School of Medicine, *Palo Alto, California* 94305 (NCA 2-745709)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**6.0004, IMMUNOREGULATORY ACTIVITY OF INTERFERON**
*T. MERIGAN*, Stanford University, School of Medicine, *Palo Alto, California* 94305 (NCA 2-745707)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**6.0005, MECHANISM OF COMPENSATION FOR VESTIBULAR LESIONS AND INTEGRATIVE FUNCTIONS IN CONTROL OF EQUILIBRIUM**
*T.H. BULLOCK*, Univ. of California, Scripps Inst. of Oceanography, *San Diego, California* 92038 (NSG 9048)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**6.0006, DEVELOPMENT OF 3-D RECONSTRUCTION TECHNIQUES FOR ULTRASTRUCTURAL MODELING OF BASIC UNITS OF ORGANIZATION IN THE CENTRAL NERVOUS SYSTEM**
*S.C. RAPISARDI*, Univ. of California, Graduate School, *San Francisco, California* 94122 (NCA 2-665706)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**6.0007, HYBRIDIZATION OF BIOMEDICAL CIRCUITRY**
*F.P. VENDITTI*, Univ. of Denver, Graduate School, *Denver, Colorado* 80210 (NAS 9-15206)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**6.0008, MEMBRANES AND CIRCADIAN RHYTHMS IN PLANTS**
*A.W. GALSTON*, Yale University, Graduate School, *New Haven, Connecticut* 06520 (NSG 7290)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**6.0009, NEUROTRANSMITTER INVOLVEMENT IN THE CENTRAL CONTROL OF THE STRESS RESPONSE**
*K.J. KELLAR*, Georgetown University, Graduate School, *Washington, District of Columbia* 20007 (NCA 2-258701)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**6.0010, QUALITY ASSURANCE SYSTEM IN CLINICAL PRACTICE SETTINGS**
*P. CHANG*, Howard University, Graduate School, *Washington, District of Columbia* 20001 (NAS 5-23799)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**6.0011, CHARACTERIZATION AND ELUCIDATION OF THE MECHANISM OF MECHANICAL STRESS INHIBITION OF PLANT GROWTH**
*C.A. MITCHELL*, Purdue University, Agric. Experiment Station, *Lafayette, Indiana* 47907 (NSG 7278)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**6.0012, BASELINE STUDY ON THE EMBRYONIC DEVELOPMENT OF THE MOUSE CRANIAL SENSORY SYSTEMS**
*J.R. KEEFE*, Univ. of Louisville, School of Medicine, *Louisville, Kentucky* 40202 (NAS 9-15213)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**6.0013, HEALTH CHANGES IN AIR TRAFFIC CONTROLLERS**
*UNKNOWN*, Boston University, Graduate School, *Boston, Massachusetts* 02215 (FA38619; FA73WA-3211)

Biomedical research study for the purpose of determining the kinds and degrees of health changes occurring in ATC, and the cause of such changes.

SUPPORTED BY U.S. Dept. of Transportation - Off. Sec.

**6.0014, POTENTIAL USE OF NUTRITIONAL FACTORS TO OPTIMIZE PERFORMANCE UNDER STRESS**
*H.N. MUNRO*, Mass. Inst. of Technology, School of Science, *Cambridge, Massachusetts* 02139 (NAS 9-15194)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**6.0015, THE EFFECT OF GRAVITY AND WEIGHTLESSNESS ON THE DEVELOPMENT AND REGENERATION OF THE GIANT COENOCYTE CAULERPA**
*W.P. JACOBS*, Princeton University, Graduate School, *Princeton, New Jersey* 08540 (NSG 7280)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**6.0016, SPAR PROJECT - COUNTER-CURRENT DISTRIBUTION OF BIOLOGICALS**
*D.E. BROOKS*, Univ. of Oregon, School of Medicine, *Portland, Oregon* 97201 (NAS 8-32353)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**6.0017, MEDICAL INFORMATION MANAGEMENT SYSTEM**
*J.W. FRANKOWSKY*, Lincoln University, Graduate School, *Lincoln University, Pennsylvania* 19352 (NAS 5-23800)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**6.0018, SPONTANEOUS AND EVOKED ACTIVITY OF THE STATORECEPTORS OF THE BULLFROG AS A RESULT OF WEIGHTLESSNESS**
*T. GUALTIEROTTI*, Univ. of Pittsburgh, Graduate School, *Pittsburgh, Pennsylvania* 15213 (NSG 2197)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**6.0019, INVESTIGATION OF MEDICAL INFORMATION MANAGEMENT SYSTEM APPLICATION IN A COMPLEX HEALTH CARE FACILITY**
*R.S. ANDERSON*, Meharry Medical College, School of Medicine, *Nashville, Tennessee* 37208 (NAS 5-23801)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

## MATHEMATICAL AND COMPUTER SCIENCES

Includes Mathematical and Computer Sciences (general); Computer Operations and Hardware; Computer Programming and Software; Computer Systems; Cybernetics; Numerical Analysis; Statistics and Probability; Systems Analysis; and Theoretical Mathematics.

**7.0001, NUMERICAL CALC OF FLOW IN A CASCADE WITH SPLITTER VANES**
*L. WALLIT*, Numerical Continuum Mech. Inc., *Woodland Hills, California* 91364 (DF459160; F33615-76-C-2011)

There are three technical objectives: (1) to test the accuracy of the contractor's three-dimensional transonic, viscous numerical flow model against appropriate experimental data, (2) to obtain a description of the three-dimensional flow in a specific axial compressor blade row containing splitter vanes, and (3) to assist in establishing the validity of a cascade test incorporating converged side walls. The application of the results is in improved accuracy of compressor blade- row designs resulting in higher efficiency and reduced development costs for aircraft turbine engines.

The contractor has developed a computer code for three-dimensional transonic, viscous flow calculations under company and NASA support. Its accuracy has not yet been verified by comparison with adequate experimental data. Under this contract, the contractor will evaluate his numerical model by using it to calculate the three-dimensional flow field for a specific blade-row geometry for which the Air Force has extensive experimental data and for which it is desired to learn more about three-dimensional characteristics of the configuration which were not possible to measure. The greatest problem area associated with three-dimensional, transonic, viscous flow calculations is the turbulence model used. This effort will also explore an improved turbulence model.

ADDENDA: Supporting agency address is: AF Eero-propulsion Laboratory TBC, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense - Air Force

**7.0002, COMPUTER DATA PROCESSING**
*K.C. GRAY*, U.S. Dept. of Commerce, Environmental Research Labs., *Boulder, Colorado* 80302 (8C370407)

PROJECT OBJECTIVE: Computer programming and processing assistance, data reduction, and in-house computer facility software management to suport NSSL observational and research project. Programming emphasizes data preparation, archival, and presentation of two- and three- dimensional data sets and incremental plotting routines.

CURRENT YEAR PLAN: Support in-house medium-core, fast-memory-cycle computer system, and develop and monitor software. Expand software for stand-alone X-Y reader-plotter system. Provide programming and processing assistance as requested by project scientists. Support development in data acquisition systems and Doppler processors. Complete software and implement NSSL-developed batch-processing terminal.

PROGRESS REPORT: Implemented assembly routines to facilitate Doppler data processing. Conducted feasibility studies for in-house computer system. Prepared specifications for A/D and plotter system. Assisted in specification and preparation for Doppler processor. Completed hardware/software design for batch-processing terminal.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

**7.0003, NUMERICAL ANALYSIS**
*T.B. GRAY*, U.S. Dept. of Commerce, Environmental Research Labs., *Boulder, Colorado* 80302 (8DJ4 09 40)

Provide consulting and programming services in the area of numerical analysis and computer utilization in support of work on the solar-terrestrial environment model.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

**7.0004, DIGITIZING OF LANDSAT DATA**
*R.G. SHACKELFORD*, Georgia Inst. of Technology, Graduate School, *Atlanta, Georgia* 30332 (NAS 8-32397)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**7.0005, JOINT COOPERATIVE PROGRAM IN COMPUTER GRAPHICS**
*D.C. ANDERSON*, Purdue University, Graduate School, *Lafayette, Indiana* 47907 (NSG 2192)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**7.0006, PERIODIC ANALYSIS OF LARGE SPACE STRUCTURES**
*T.J. MCDANIEL*, Iowa State Univ. of Sc. & Tech, School of Engineering, *Ames, Iowa* 50011 (NSG 1372)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**7.0007, A STUDY OF THE ORGANIZATION AND OPERATION OF THE AMES DATA NETWORK**
*R.M. HARALICK*, Univ. of Kansas, School of Engineering, *Lawrence, Kansas* 66044 (NCA 2-365701)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**7.0008, PROCESSING AIR QUALITY DATA**
*C.M. BUTLER*, Mississippi St. University, School of Business & Industry, *Mississippi State, Mississippi* 39762 (NSG 1375)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**7.0009, DATA BASE MANAGEMENT APPLICATIONS**
*L. EASTWOOD*, Washington University, School of Engin. & Appl. Sci., *St. Louis, Missouri* 63130 (NAS 8-32354)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**7.0010, INTERACTIVE 2-DIMENSIONAL PROGRAMMING AND INTEGRATED COMPUTER INPUT-OUTPUT**
*M. KLERER*, Polytechnic Inst. of New York, Graduate School, *Brooklyn, New York* 11201 (MCS75-22569)

Research will be continued into the basic structure, design, and analysis of computer languages which use two-dimensional input-output, involve context-dependent constructs, permit extensible alphabets and user-defined language and graphical constructs, and are user-oriented to the scientific-mathematical-engineering environment. The investigation also concerns itself with the reactive behavior of the user within the man-machine interactive process when an integrated systems approach is used for the design of various input-output techniques of differing efficacy. Concomitant to this research is the automation of those intellectual processes involved in the performance of applied mathematics. Three specific projects contemplated are: a. Continuation of the research into the computer input of hand-printed mathematical expressions and the optical recognition of typed or printed mathematics. This is relevant to the goal of ultimately automating applied mathematics and direct computer recognition of mathematical text in normal form. b. Implementation of the Klerer-May programming system at Polytechnic Institute of New York into a 'production' system useful to students and faculty. This activity is relevant to further study of the reactive behavior of the user in the environment of such a unique automated programming system. c. If resources permit, it is planned to continue studies into the operational effects on time-sharing when nonconventional language systems are used. Further results would be relevant to understanding the efficiency of the time-sharing mode.

SUPPORTED BY U.S. Natl. Science Foundation

**7.0011, A STUDY OF REAL-TIME COMPUTER GRAPHIC DISPLAY TECHNOLOGY FOR AERONAUTICAL APPLICATIONS**
*R.W. STROH*, Univ. of North Carolina, School of Engineering, *Raleigh, North Carolina* 27607 (NSG 1355)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**7.0012, EVALUATION METHOD FOR TRANSONIC CONE BOUNDARY LAYER TRANSITION DATA BY MEANS OF COMPUTER SIMULATION**
*P.M. MORETTI*, Okla. St. Univ., School of Engineering, *Stillwater, Oklahoma* 74074 (NCA 2-575701)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**7.0013, FINITE ELEMENT ANALYSIS OF PERIODIC TRANSONIC FLOW PROBLEMS**
*G.J. FIX*, Carnegie Mellon University, Mellon Institute of Science, *Pittsburgh, Pennsylvania* 15213 (NSG 1367)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**7.0014, LEAST SQUARES METHODS FOR TRANSONIC FLOWS ABOUT OSCILLATING WINGS**
*M.D. GUNZBURGER*, Univ. of Tennessee, Graduate School, *Knoxville, Tennessee* 37916 (NSG 1366)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**7.0015, IMAGING RADAR MATH MODEL AND AIRBORNE IMAGING RADAR DATA COLLECTING SYSTEM**
*A.J. TUCKER*, Univ. of Texas, Applied Research Laboratories, *Austin, Texas* 78712 (NAS 9-15217)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**7.0016, METHODOLOGY FOR CONFIDENCE OF REPLACEMENT REQUIREMENTS**
*B. OSTROFSKY*, Univ. of Houston, School of Business Admin., *Houston, Texas* 77004 (NAS 9-15215)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**7.0017, REGRESSION IN THE PRESENCE OF CORRELATED ERRORS**
*R.H. MYERS*, Virginia Poly. Inst. & St. U., School of Arts & Sciences, *Blacksburg, Virginia* 24061 (NSG 1376)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**7.0018, DEVELOPMENT OF A FLUIDIZED BED COMPUTER MODEL**
*C.Y. WEN*, West Va. University, School of Engineering, *Morgantown, West Virginia* 26506 (NSG 3134)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

## PHYSICS

Includes Physics (general); Acoustics; Atomic and Molecular Physics; Nuclear and High-energy Physics; Optics; Plasma Physics; Solid-state Physics; Thermodynamics and Statistical Physics. For Related Information See Also Engineering.

**8.0001, SPECKLE HOLOGRAPHY**
*A.M. MARTIN*, Athens College, Undergraduate School, *Athens, Alabama* 35611 (NAS 8-32220)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**8.0002, COHERENT OPTICAL PHENOMENA AND SOLID-STATE SPIN RESONANCE**
*E.L. HAHN*, Univ. of California, School of Letters & Science, *Berkeley, California* 94720 (DMR73-02658 A02)

Investigations of both optical coherence and spin-resonance phenomena in condensed-matter systems, previously supported under DMR- 7302658, will be continued. Principal emphasis will be on the study of: I. Coherent Electric Dipole Radiation in Gases; II. Coherent Pulse Propagation and Self-Induced Transparency; III. Coupling of Gyromagnetic Electronic Spin Systems to Lattice Vibrations; and IV. Nuclear Double- Resonance Spectroscopy.

SUPPORTED BY U.S. Natl. Science Foundation

**8.0003, RESEARCH IN NUCLEAR PHYSICS AT LOW AND INTERMEDIATE ENERGIES**
*F. BOEHM*, Calif. Inst. of Technology, Graduate School, *Pasadena, California* 91109 (EY-76-C-03-0063)

Time-reversal experiments with polarized nuclei will be conducted by measuring the linear polarization of gamma rays. Attention will be directed to the final state effects. Studies of the Klein-Gordon equation will be conducted at LAMPF. The fine structure splitting of pionic X rays will be measured precisely using a crystal spectrometer. Other properties of pionic atoms will be investigated, notably strong interaction effects on inner transitions. Circular polarizations of muonic 2p-ls transitions will be measured at LAMPF to explore depolarization mechanisms in the muonic cascade. Nuclear moments and charge parameters in Pd and Re will be found from the hyperfine structure of muonic atoms. The basic properties of neutrinos will be investigated with focus on neutrino cross sections and neutrino oscillations, as a collaborative effort in Grenoble.

RESULTS: 1. From studies of the linear polarization correlation from polarized nuclei the time-reversal phase was found: sin eta equals (-3.1 plus or minus 6.5) x 10 to the minus 4th power. 2. Neutral current effects on the 2s-ls atomic transition were searched and a limit was set. 3. Chemical shifts of K X rays in uranium were measured, including the shift of the K edge. 4. Nuclear properties for 161Dy, 165Ho and 181Ta were observed from muonic and x ray studies at LAMPF and properties for F, Mg, and Na from pionic x rays at SREL. 5. Capture of negative muons and nuclear polarization were calculated.

SUPPORTED BY U.S. Energy Res. & Dev. Admin. - P.R.D.

**8.0004, HETERONUCLEAR SPIN DYNAMICS AND NEW TOOLS FOR CHARACTERIZATION OF BULK AND SURFACE PROPERTIES OF SOLIDS**
*R. VAUGHAN*, Calif. Inst. of Technology, Graduate School, *Pasadena, California* 91109 (NSG 7275)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**8.0005, EXPERIMENTAL STUDY OF ELECTRON-MOLECULE (ATOM) COLLISION PROCESSES**
*S. TRAJMAR*, U.S. Natl. Aero. & Space Adm., Jet Propulsion Laboratory, *Pasadena, California* 91109 (INT76-22192)

This collaborative research project involves Dr. Sandor Trajmar of the Jet Propulsion Laboratory (Pasadena, California), with Drs. Sergio Porto, George Csanak, and Dimitrios Bozinis of the University of Campinas (Campinas, Brazil).

NSF is contributing to the linkage of these scientists for the purposes of expanding their research efforts in electron-molecule (atom) collision physics. The joint research efforts will be concentrated in areas which are of importance from the point of view of laser and plasma physics, isotope separation, and surface chemistry and physics. Three specific research areas have been chosen: a) Electron scattering from atomic and molecular beams. This will involve experimentation with lasers in metal vapors, and vibrational excitation of diatomic and polyatomic molecules. b) Isotope separation. Exploratory research on isotope separation through combinations of laser photoexcitation followed by selective photoionization or chemical reactions will be carried out. c) Electron scattering from surfaces. Here planning and feasibility studies will be done to utilize low- and intermediate-energy elastic and inelastic electron scattering for probing surfaces.

The laboratory measurements will be carried out at JPL by the two main investigators from each country. The evaluation and interpretation of the results will be shared and carried out at Campinas and JPL, and will be closely correlated with ongoing theoretical work at Campinas under Dr. Csanak.

SUPPORTED BY U.S. Natl. Science Foundation

**8.0006, CATALYSIS AND SOLID-STATE PHYSICS**
*M.B. MAPLE*, Univ. of California, Graduate School, *San Diego, California* 92037 (DMR76-24178)

A continuation of research funded by NSF grant DMR75-23385 will be pursued. This is a joint theoretical and experimental effort to study the various problems concerning the chemisorption of gases and the catalysis of chemical reactions over solid substrates.

SUPPORTED BY U.S. Natl. Science Foundation

**8.0007, MOSSBAUER STUDIES OF MATRIX-ISOLATED MOLECULES**
*P.H. BARRETT*, Univ. of California, School of Letters & Science, *Santa Barbara, California* 93106 (DMR76-23329)

Mossbauer and infrared spectroscopy will be used to study the bonding of the iron-dinitrogen compound that has been recently identified in solid iron-nitrogen solutions. The bonding of other ligands (e.g., CO, NO, H2) to iron in a rare-gas matrix will also be explored. The study of these molecules is relevant to the understanding of the fundamental reactions in catalytic processes. Also the superconductivity of tin/inert-gas mixtures will be studied to probe the effects of surface phonon-softening and/or excitonic mechanism on the superconducting transition temperature.

This is a continuation of research supported under DMR71-01757.

SUPPORTED BY U.S. Natl. Science Foundation

**8.0008, MAGNETIC CRYSTALS WITH WEAK INTERACTIONS**

*W.P. WOLF*, Yale University, Graduate School, *New Haven, Connecticut* 06520 (DMR76-23102)

Research previously funded under grant DMR73-02405 will be continued. The work covers several related areas: 1. Experimental studies of multicritical points, including work on tricritical, bicritical and wing critical points. 2. Domain studies near phase transitions. 3. High-frequency relaxation measurements of magnetic specific heats. 4. High-sensitivity magnetometry, development of a SQUID magnetometer. 5. Phonon contributions to bulk magneto- thermodynamic properties, a heat capacity study of non-additive effects. 6. Phase transitions in mixed crystals including mixed antiferromagnetic-ferromagnetic and antiferromagnetic-diamagnetic crystals. 7. Preparation of new magnetic materials, including high- pressure hydrothermal synthesis of rare-earth hydroxides and hydroxy carbonates. The principal objective of all these studies is to seek direct confrontation between theory and experiment, with a view to improving our understanding of the microscopic processes important in magnetic materials.

This is the first year of a 3-year continuing grant.

SUPPORTED BY U.S. Natl. Science Foundation

**8.0009, BASIC STUDIES OF ATOMIC DYNAMICS**

*U. FANO*, Univ. of Chicago, School of Physical Sciences, *Chicago, Illinois* 60637 (EY-76-S-02-1674)

This continuing project tries to unravel the correlations between the motions of different particles and the energy exchanges between different types of motion in electron collision and photoabsorption processes. Procedures are under development to weld together the R- matrix approach to collisions and spectra and the analysis of correlations of excited electrons. In this context we have initiated the development of a new concept of post-adiabatic analysis of collisions; this effort is expected to continue. Additional current tasks deal with the angular distributions of collision products and with the application of atomic points of view to crystal lattice phenomena. Calculations of benchmark data on the spectral and collision properties of all ions of all elements are being carried out as a cooperative informal project by this and other groups. Particular attention is being given to the identification and development of optimal procedures for the calculation of ionization cross sections, especially for highly stripped ions.

SUPPORTED BY U.S. Energy Res. & Dev. Admin. - P.R.D.

**8.0010, LUMINESCENCE AND LASER STUDIES ON III-V SEMICONDUCTORS**

*N. HOLONYAK*, Univ. of Illinois, School of Engineering, *Urbana, Illinois* 61801 (DMR76-81432)

This project will involve luminescence and laser studies in III-V semiconductors. The principal materials will be indium (In)-gallium (Ga)-phosphorous (P)-arsenic (As) alloys grown by the liquid-phase- epitaxy technique. The studies will be in two parts: (1) Examination of nitrogen impurity trapping in the quaternary alloy In1-yGayP1-zAsz, the knowledge of which is important for efficient light emission, and (2) the construction and study of double heterojunction laser diodes which show the transition from inhomogeneous to homogeneous line broadening as current is increased. Here the heterojunction materials are In1-xGaxP1-zAsz on a GaAs1-yPy substrate. A major goal will be to prepare improved visible spectrum, large heterobarrier single and double heterojunction light emitting diodes and lasers.

This is a renewal of NSF Grant DMR72-03045.

SUPPORTED BY U.S. Natl. Science Foundation

**8.0011, TWO-BODY DISSOCIATION OF LIGHT NUCLEI AND NUCLEAR FIELDS**

*R.W. HUGGETT*, Louisiana State Univ. Systems, School of Chemistry & Physics, *Baton Rouge, Louisiana* 70803 (EY-76-S-05-4699)

The objective of the experiment is to measure the cross sections for the dissociation of light nuclei into two-body nuclear final states during peripheral nuclear collisions. The cross section for dissociation into a specific two-body nuclear final state is proportional to the square of the probability that the projectile nucleus existed as a configuration of the two final-state nuclei at the time of collision. The results will be significant because there has been increasing speculation recently concerning the existence of short- lived conglomerates of nucleons called 'clusters' within a parent nucleus.

The experiment will employ beams of 20/10 Ne, 16/8 O, 14/7 N, 12/6 C, 10/5 B, 6/3 Li, 4/2 He, and 2/1 H ions.

The kinetic energy of the heavy ions will be 2.1 GeV per nucleon. Those interactions in which the projectile nucleus dissociates into two fragments within the target will be selected electronically and recorded on magnetic tape for analysis.

The measured quantities will include the trajectories and charges of the incident nucleus and both final-state nuclei. The momenta of both final-state nuclei will be deduced from their bending angles in a magnetic field of 38 kG-m. Wire spark chambers with magnetostrictive readout will be used to encode the positions of projectile and final- state nuclei. Charges will be measured in scintillation counter hodoscopes.

SUPPORTED BY U.S. Energy Res. & Dev. Admin. - P.R.D.

**8.0012, CALCULATION OF TOTAL CROSS SECTIONS FOR CHARGE EXCHANGE IN MOLECULAR COLLISIONS**

*J.W. IOUP*, Xavier University of Louisiana, School of Arts & Sciences, *New Orleans, Louisiana* 70125 (NSG 1361)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**8.0013, STUDY OF ATOMIC PROPERTIES OF ASTROPHYSIC IONS AND ATOMS**

*F.W. MARTIN*, Univ. of Maryland, School of Engineering, *College Park, Maryland* 20740 (NCA 5-65)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**8.0014, ULTRAVIOLET STUDY OF V PUGGIS**

*B.P. FLANNERY*, Harvard University, Graduate School, *Cambridge, Massachusetts* 02138 (NSG 5143)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**8.0015, SHUTTLE BASED VERY LONG BASELINE INTERFEROMETRY**

*B.F. BURKE*, Mass. Inst. of Technology, School of Science, *Cambridge, Massachusetts* 02139 (NSG 5150)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**8.0016, ABSORPTION OF CO2 LASER RADIATION IN DENSE PLASMAS**

*D.R. BACH*, Univ. of Michigan, School of Engineering, *Ann Arbor, Michigan* 48106 (ENG76-20279)

The main objective of this research program is to study nonlinear interaction phenomena which arise when the radiation from a high- intensity CO2 laser beam interacts with a dense plasma. The interaction phenomena to be studied are closely related to mechanisms that are important in the coupling of laser light to pellet materials. Experiments will be carried out with a Lumonics Model 601 oscillator using a small, high-density Z-pinch plasma which has electron densities that exceed the critical density for CO2 radiation. The work includes a study of the Stimulated Brillouin scattering from the Z-pinch, a study of the scattering of Ruby laser light from the plasma in order to detect the onset of acoustic oscillations, a measurement of the transmission of CO2 light through the Z-pinch as a function of the incident intensity, and calculations involving all of these experiments.

This is a continuation of research previously supported under NSF grant ENG-7414366.

SUPPORTED BY U.S. Natl. Science Foundation

**8.0017, HIGH-ENERGY INTERACTIONS**
*M.A. ABOLINS*, Michigan State University, School of Natural Sciences, *East Lansing, Michigan* 48824 (PHY76-01730 A02)

A comprehensive program for the investigation of strong interactions is in progress. 1. High-energy antiproton-proton interactions in the Fermilab 30-inch bubble chamber hybrid system (Fermilab E-311, E-392). 2. High-energy pp and pi-p interactions in the Fermilab 30-inch hybrid system (Fermilab E-2B, E-281). 3. Inclusive production of short-lived neutral Kaon by negative Kaon on hydrogen (Fermilab. E-383). 4. Intermediate-energy antiproton-proton annihilation studies (SLAC. BC-64). 5. Triple-bond search and intermediate energy negative Kaon-pion interactions (ANL. E-289, CERN. T-209).

This work represents a continuation of that currently supported by Foundation grant PHY76-01730 AO1.

SUPPORTED BY U.S. Natl. Science Foundation

**8.0018, EXPERIMENTAL NUCLEAR PHYSICS**
*J.M. BLAIR*, Univ. of Minnesota, Inst. of Technology, *Minneapolis, Minnesota* 55455 (EY-76-C-02-1265)

This contract is for operation of the Minnesota MP Tandem Van de Graaff for the first 6 months of 1977. During that period the accelerator and associated auxiliary equipment will be used for experiments in the following areas: Reactions and scattering of beams of p, d, t, 3He, 4He and heavier ions on a variety of targets to accumulate data and carry out its analysis which will provide information about nuclear energy levels and reaction mechanisms. The study of hyperfine levels of atoms using laser beams should provide information on nuclear structure parameters.

RESULTS: During 1976 beams of p, d, 3He, 4He, 15N, 16O, 17O, 18O, and 19F were used to study a wide variety of nuclear reactions and scattering processes. These experiments produced information about elastic and inelastic scattering of both light and heavy ions, about one and two nucleon transfer reactions in a wide variety of targets, and the resulting excited states and nuclear vibrations.

SUPPORTED BY U.S. Energy Res. & Dev. Admin. - P.R.D.

**8.0019, THEORETICAL PARTICLE PHYSICS**
*J.B. BRONZAN*, Rutgers the State University, School of Arts & Sciences, *New Brunswick, New Jersey* 08903 (PHY76-24312)

Work will continue on the following areas: Reggeon Field Theory; Relation between renormalization group and Regge singularities; Calculation of scaling indices; Polarization phenomena at high energy. This work represents a continuation of that currently supported by Foundation grant PHY75-06857 AO2.

SUPPORTED BY U.S. Natl. Science Foundation

**8.0020, EXPERIMENTAL RESEARCH IN ELEMENTARY PARTICLE PHYSICS**
*T.J. DEVLIN*, Rutgers the State University, School of Arts & Sciences, *New Brunswick, New Jersey* 08903 (PHY76-81059)

The program in progress contains three major parts: 1. Neutral hyperon experiments at Fermilab. A series of experiments is being performed using the hyperon beam as a source of neutrals Kaon zero, lambda zero, lambda zero bar, Xi zero, and Xi zero bar. Inclusive production cross sections and polarization; total cross sections on hydrogen and deuterium; elastic scattering with polarization; lambda zero magnetic moment; delta S equals 2 transitions; Xi zero bar decay asymmetry parameter. 2. Neutrino scattering at Fermilab. Three major goals of this experiment are to: study the space time structure of neutral currents, measure the deep inelastic structure functions in neutrino scattering, investigate the phenomenon which leads to multimuon final states. 3. Antiproton-proton annihilations into neutral V pairs at Brookhaven. The experiment will be a sensitive search for narrow resonances above the proton-antiproton threshold. The data are also related by the triple Regge model to the inclusive production experiment in the neutral hyperon beam at Fermilab.

This work represents a continuation of that currently supported by Foundation grant MPS72-04871 A06.

SUPPORTED BY U.S. Natl. Science Foundation

**8.0021, NUCLEAR CHEMISTRY PROJECT**
*R.A. NAUMANN*, Princeton University, Graduate School, *Princeton, New Jersey* 08540 (EY-76-S-02-2184)

The proposed program provides for the continuation of research in areas that have previously received support from the United States Energy Research Development Agency in the past contract period.

The negative mu meson research at Los Alamos has advanced beyond the initial exploratory phase. The approved LAMPF experiment 288 will directly test whether or not individual atoms in a mixture may be assigned an effective muon capture cross section which is independent of the nature of the other atoms present in the mixture. Attention will also be given to the development of slow muon beams with energies of less than 5 keV, an important capability for future research concerned with mu minus capture.

The main focus of the nuclear hyperfine research will be to further explore the variation of the symmetry of the electric field gradient with temperature for atoms implanted in rare-earth metal hosts recently observed in our laboratory. Additionally we intend to develop capability for time-dependent perturbed angular correlation studies on small samples at ultra-high pressure.

The nuclear spectroscopy program will emphasize the development of radioactive targets or transfer spectroscopy using Q3D spectrometers and the installation of a high-transmission moderate,, resolution electron spectrometer in a beam-line of the Princeton cyclotron for in-beam spectroscopy.

SUPPORTED BY U.S. Energy Res. & Dev. Admin. - P.R.D.

**8.0022, RESEARCH IN MEDIUM AND HIGH ENERGY ATOMIC PHYSICS THEORY**
*V. FRANCO*, City University of New York, School of Liberal Arts, *Brooklyn, New York* 11210 (NSG 1378)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**8.0023, INTERACTION OF HIGH-POWER-DENSITY ELECTROMAGNETIC WAVES AND MATERIALS**
*N. MARCUVITZ*, Polytechnic Inst. of New York, School of Science & Engin., *Brooklyn, New York* 11201 (ENG76-21829)

The interaction of moderately intense laser beams with materials will be investigated. Interest will center on the 10 to the 4th power - 10 to the 14th power watts/cm2 power range where material properties are radically altered by field-dependent processes which are space- and time-dependent during the interaction. These processes result in melting and ablation of the surface, the formation of an ionized plasma corona that expands outward from the material surface, and the excitation of shock and thermal conduction waves that progress into the material. The dynamics of energy absorption and material changes will be investigated theoretically and by numerical modeling methods using both kinetic and fluid dynamic points of view.

SUPPORTED BY U.S. Natl. Science Foundation

**8.0024, COLLISION DYNAMICS WITH HIGH-ENERGY OXYGEN ATOMS**
*R.P. MERRILL*, Cornell University, Graduate School, *Ithaca, New York* 14850 (NSG 1371)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**8.0025, NUCLEAR FISSION STUDIES**
*W.W. HAVENS*, Columbia University, School of Engineering, *New York, New York* 10027 (EY-76-S-02-2176)

The proposed research program is a continuation of the research of Professors Havens and Melkonian, and Dr. Felvinci using the Oak Ridge Electron Linear Accelerator (ORELA) at Oak Ridge as pulsed neutron sources for time-of-flight measurements. The main areas of research are: 1) Fission measurements

on the isotopes 229Th, 233U, 235U, 237Np, and 239Pu. Event-by-event data are recorded for both the time-of-flight of the neutron inducing fission as well as the energy (actually pulse height in the solid-state detector) of one of the fission fragments. Improved results are to be obtained for the fission fragment kinetic energy distributions for the various resonance levels. Past experience indicates that there are significant differences in these distributions for the various levels. This is of interest in itself for correlation with the variations in the mass distributions and with the J and K quantum numbers of the levels. In addition, these differences in fission fragment kinetic energy distributions have implications in the measurement of the fission cross section as a function of neutron energy. The sum over all fragment kinetic energies at each neutron time-of-flight gives, for the case of a suitably thin sample and after background correction and flux normalization, the correct fission cross- section as a function of neutron energy. Many other experimenters use fission fragment detection systems which omit a considerable fraction of the fission fragments and, hence, may bias their cross-section results. This may be a partial source of the sizable discrepancies between results from the various laboratories. This aspect of the work will receive particular emphasis in the next run at ORELA. 2) Similar measurements as 1) but using solid-state detectors to record the energies of both fission fragments so that total energy and mass distribution can be obtained as a function of neutron energy. 3) Measurement of capture cross sections using Moxon-Rae type detectors. 4) Study of neutron bias backgrounds using Monte Carlo techniques.

RESULTS: These experiments were successful: data on 229Th, 233U, 235U, and 239Pu fission have been taken and partially analyzed. A new way of presenting cross section vs. energy with energy intervals related to the resolution is also described. (Text Abridged.)

SUPPORTED BY U.S. Energy Res. & Dev. Admin. - P.R.D.

**8.0026, THEORETICAL HIGH-ENERGY PHYSICS**
*T.D. LEE*, Columbia University, School of Arts & Sciences, *New York, New York* 10027 (E(11-1)-2271)

The investigations of the Columbia Theoretical Group have been and will continue to be concerned with all theoretical aspects of high- energy physics. Our main efforts will lie in the areas of particle physics, field theory and symmetry principles, including their extensions to related problems in atomic and nuclear physics, astrophysics and statistical mechanics. We shall continue our close relationships with groups carrying out experiments at Nevis, Brookhaven, SLAC, Argonne, Berkeley, NAL and CERN. We shall attempt to maintain a broad view of the prospects of high-energy physics which may be useful in the future determination of national scientific policy.

SUPPORTED BY U.S. Energy Res. & Dev. Admin. - P.R.D.

**8.0027, ENERGY TRANSFER BETWEEN MOLECULAR COLLISION SYSTEMS AND LASER RADIATION FIELDS**
*T.F. GEORGE*, Univ. of Rochester, School of Arts & Sciences, *Rochester, New York* 14627 (NSG 2198)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**8.0028, COHERENCE IN ELECTROMAGNETIC INTERACTIONS**
*L. MANDEL*, Univ. of Rochester, School of Arts & Sciences, *Rochester, New York* 14627 (PHY75-09719 A02)

Research will continue on interactions between electromagnetic fields and atomic systems, in which coherence effects play a major role. Investigations will be continued of the interaction between single atoms and resonant light by an atomic beam technique, of superradiance or collective spontaneous emission by a coherently excited atomic system, and of the coherence properties of a tunable laser near threshold. The digital photon correlation technique developed earlier will be applied to several of these problems.

SUPPORTED BY U.S. Natl. Science Foundation

**8.0029, GENERATION OF STABLE HIGH SECONDARY ELECTRON YIELD SURFACES BY ION IMPLANTATION FOR ELECTRON MULTIPLIER AND P-N JUNCTIONS (ABBREV)**
*F.A. WHITE*, Rensselaer Polytechnic Inst., School of Engineering, *Troy, New York* 12181 (NSG 1360)

Generation of stable high secondary electron yield surfaces by ion implantation for electron multiplier and P-N junctions for electron spectrometric instruments.

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**8.0030, TRITIUM DIFFUSION IN NONMETALLIC SOLIDS OF INTEREST FOR FUSION REACTORS**
*T.S. ELLEMAN*, Univ. of North Carolina, School of Engineering, *Raleigh, North Carolina* 27607 (E(40-1)-4721)

Ceramic materials may find extensive application in fusion reactors as tritium barriers and structural components. A knowledge of the tritium permeability and diffusion coefficients in these materials will be necessary for an evaluation of the tritium buildup and transport in the blanket and tritium separation systems.

Tritium diffusion, permeation, and solubility coefficients will be measured for selected oxides, carbides, and nitrides of potential interest for fusion reactors. Diffusion coefficients will be obtained by recalling tritium into specimens through transmutation of a surface blanket of Li-enriched salt and measuring the tritium release rates during isothermal annealing.

Materials either under study or proposed for study include alumina, beryllia, yttria, Lucalox, Yttralox, pyrolytic carbon, silicon carbide, silicon nitride, the oxy-ritrides, and silica.

As more information becomes available on fusion reactor systems, the results will be used to calculate tritium transport rates and inventories in the blanket and recovery systems.

RESULTS: Tritium diffusion coefficients have been measured in a number of nonmetallic solids which have potential use as diffusion barriers or protective coatings in fusion reactors. Results have been obtained for various forms of alumina, beryllia, yttria, silicon carbide, boron carbide, glass, and pyrolytic carbon. The method of measurement involved tritium injection into solids followed by measurements of tritium release rates during heating. Measured diffusion coefficients were significantly below the hydrogen diffusion coefficients determined for metals so nonmetallics would appear to have potential for being effective tritium barriers.

Preliminary hydrogen solubility measurements have been conducted with alumina and silicon carbide by measuring the amount of dissolved deuterium which is released from equilibrated specimens during heating. The technique appears to be a satisfactory means for determining temperature and pressure effects on solubility. Solubility information should be useful in determining both tritium inventories and permeation rates in CRT blanket components.

SUPPORTED BY U.S. Energy Res. & Dev. Admin. - C.T.R.D.

**8.0031, BAND STRUCTURE OF DILUTE ALLOYS**
*W.L. GORDON*, Case Western Reserve Univ., Graduate School, *Cleveland, Ohio* 44106 (DMR75-02716 A01)

Studies of band structure changes in dilute alloys using the de Haas-van Alphen effect previously supported by NSF grant DMR75-02716 will be continued. The relationship of these changes to the electron scattering as it influences the Dingle temperature will also be explored. In particular, a nonlocal pseudopotential model for Be and its alloys will be extended to provide estimates of the scattering over several important orbits on the Fermi surface. Work on dilute CdMg alloys will be continued in completing Dingle temperature and orbital g- factor determinations.

SUPPORTED BY U.S. Natl. Science Foundation

**8.0032, RADIATION-INDUCED VOIDS BY POSITRON ANNIHILATION**
*J.D. MCGERVEY*, Case Western Reserve Univ., Graduate School, *Cleveland, Ohio* 44106 (DMR74-07190 A01)

Studies of radiation-induced voids and other defects in metals using measurements of positron lifetimes and the angular correlation of positron annihilation radiation from these metals which were previously supported by DMR74-07190 will be continued. The research will be done in collaboration with members of the Radiation Effects and X-ray Diffraction Groups of the Metals and Ceramics Division of Oak Ridge National Laboratory, who irradiate the samples and also study them by means of small-angle X-ray scattering and transmission electron microscopy. Attempts will be made to: Clarify the effects of annealing; Observe the effect of voids of different sizes by varying the neutron fluence, and; Observe the effect of silicon impurities in Al and Al alloys by studying alloys such as Al-Mg and by irradiating samples surrounded with thermal neutron absorbers to decrease the production of Si.

SUPPORTED BY U.S. Natl. Science Foundation

**8.0033, EXPERIMENTAL NUCLEAR PHYSICS**
*P.D. BARNES*, Carnegie Mellon University, Mellon Institute of Science, *Pittsburgh, Pennsylvania* 15213 (EY-76-S-02-3244)

A search for X-rays from the fundamental K-p and p-p atomic systems will be continued in the Fall at the BNL AGS. Further runs are being planned for the spring. Low-energy elastic and inelastic pion scattering from atomic nuclei will be measured on the LEP channel at LAMPF, extending our previous work in this area. A high-resolution study of pion absorption reactions will be made with an 8 cm intrinsic Ge charged particle spectrometer which is currently being built. This spectrometer will receive its initial tests this fall. Tune-up experiments will begin in Spring leading to higher energy studies of elastic and inelastic scattering next summer. Equipment and targets for all these measurements are being designed and fabricated.

RESULTS: The techniques for low-energy pion absorption and scattering experiments have been tested. Preliminary results are available for the exotic atom measurements.

SUPPORTED BY U.S. Energy Res. & Dev. Admin. - P.R.D.

**8.0034, TRANSPORT, THERMAL AND MAGNETIC PROPERTIES OF SOLIDS**
*J.A. RAYNE*, Carnegie Mellon University, Inst. of Technology, *Pittsburgh, Pennsylvania* 15213 (DMR76-80939)

Research into the transport, thermal and magnetic properties of solids will be continued. The nature of amorphous metal alloys will be investigated by means of ultrasonic attenuation and velocity experiments, as well as by low-temperature heat capacity and transport measurements.

A study of the critical behavior of low-dimensional magnetic insulators also will be made using ultrasonic techniques. These techniques will also be applied to further investigations into the electronic scattering rate and the shear wave attenuation in transition metals. Collaborative studies on the magnetic properties of ternary palladium-silver-iron system, particularly in the spin-glass regime, will be undertaken by magnetoresistance and Mossbauer measurements.

This is a continuation of research supported under DMR73-07498.

SUPPORTED BY U.S. Natl. Science Foundation

**8.0035, FISSION INDUCED PLASMAS**
*W.L. HARRIES*, Old Dominion University, Graduate School, *Norfolk, Virginia* 23508 (NSG 1362)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**8.0036, MATERIAL SCIENCE AND SOLID STATE PHYSICS STUDIES WITH POSITIVE MUON SPIN PRECESSION**
*C.E. STRONACH*, Virginia State College, Graduate School, *Petersburg, Virginia* 23806 (NSG 1342)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**8.0037, VISUAL TECHNIQUES IN HIGH-ENERGY PHYSICS**
*H.J. LUBATTI*, Univ. of Washington, School of Arts & Sciences, *Seattle, Washington* 98105 (PHY76-23941)

A research program on a broad range of topics is in progress: 1. New Particle Search. A streamer chamber exposed to a beam of negative pions is being used to search for the production of states which decay semi-leptonically into muons and neutral strange particles. 2. Coherent Scattering. A study of coherent scattering of pions from helium nuclei is in progress with a streamer chamber at Fermilab. 3. Pion Interactions in Deuterium. A comprehensive program of pi-d interactions continues with pion momenta of 15,200 and 400 GeV/C. An exposure made in the SLAC 82 inch chamber provides a statistically large sample for comparisons with higher energy data from the Fermilab 30 inch chamber. 4. Anti-neutrino Studies. Anti-neutrino experiment with the Fermilab 15' bubble chamber filled with a heavy liquid is designed to study neutral currents and events with one, two or more muons.

This work represents a continuation of that currently supported by Foundation grant PHY72-05042 AO3.

SUPPORTED BY U.S. Natl. Science Foundation

**8.0038, SPECTROSCOPY OF MAGNETICALLY ORDERED MATERIALS**
*W.M. YEN*, Univ. of Wisconsin, School of Letters & Science, *Madison, Wisconsin* 53706 (DMR76-21574)

Recently developed laser spectroscopic techniques will be applied to the optically active ions which possess magnetic properties. Emphasis will be put on the study of the dynamics of optically excited states. The proposal is divided into complementary areas: (1) studies of static magnetooptical properties of ordered systems using ultra-high- sensitivity modulation techniques, (2) continued studies of fluorescence line narrowing and saturation spectroscopy properties of magnetic ions as dopants and as constituents of crystalline solids and (3) initiation of experiments utilizing tunable dye lasers to probe into coherence properties of magnetically ordered states.

This is a continuation of research supported under DMR73-02478 AO1.

SUPPORTED BY U.S. Natl. Science Foundation

## SOCIAL SCIENCES

Includes Social Sciences (general); Administration and Management; Documentation and Information Science; Economics and Cost Analysis; Law and Political Science; and Urban Technology and Transportation.

**9.0001, THE DETERMINANTS OF TECHNOLOGICAL INNOVATION**
*N. ROSENBERG*, Stanford University, School of Hum. & Sciences, *Palo Alto, California* 94305 (NSG 2202)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**9.0002, ANALYSIS OF THE RIDE QUALITY STIMULI OF MASS-TRANSIT SYSTEMS**
*R.H. KIRBY*, Old Dominion University, Graduate School, *Norfolk, Virginia* 23508 (NSG 1350)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

## SPACE SCIENCES

Includes Space Sciences (general); Astronomy; Astrophysics; Lunar and Planetary Exploration; Solar Physics; and Space Radiation. For Related Information See Also Geosciences.

**10.0001, OBSERVATION OF COMETS, ATMOSPHERIC EXTINCTION AND IMAGE INTENSIFIER RESEARCH**
*R.A. KASSANDER*, Univ. of Arizona, Graduate School, *Tucson, Arizona* 85721 (NCA 5-19)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**10.0002, LOW- AND INTERMEDIATE-RESOLUTION 1-5 MICRON SPECTROSCOPY**
*R.I. THOMPSON*, Univ. of Arizona, School of Liberal Arts, *Tucson, Arizona* 85721 (AST75-04810 A01)

A research program of infrared spectroscopy of galactic and extragalactic objects in the 1-5.5 micron wavelength region will be pursued. A Fourier transform spectrometer currently in operation will be used to observe M dwarf stars, carbon stars, T Tauri stars, H II regions and external galaxies. The spectra obtained with the spectrometer will be analyzed by comparison with synthetic spectra based on model atmospheres to determine chemical abundances and physical conditions in M dwarf stars and in carbon stars. Radiative transfer techniques will be used to analyze the physical conditions in H II regions and composition and conditions in T Tauri stars. These observations, especially those of the M dwarf stars, will be used along with the galactic spectra to determine the stellar population of external galaxies. Special emphasis will be placed on observations of elliptical galaxies because of their importance in the determination of the deceleration parameter of a quantity that needs evaluation for discussions concerning the expansion of the universe. Spectra of other interesting objects as determined by their optical or infrared properties will also be obtained. This is a renewal of grant AST 75-04810.

SUPPORTED BY U.S. Natl. Science Foundation

**10.0003, THE INTERSTELLAR GAS AND MAGNETIC FIELD**
*C. HEILES*, Univ. of California, School of Letters & Science, *Berkeley, California* 94720 (AST74-17362 A03)

Studies of the structure and kinematics of the interstellar gas, and of the interstellar magnetic field as revealed by Zeeman splitting of spectral lines will be carried out. Interpretation of the existing 21cm line survey data will continue, with concentration towards consideration of the ramifications of the numerous expanding neutral hydrogen (HI) shells which have been recently discovered. There will be concentration on using differencing techniques to search for structure which is small in angular scale. A search for OH molecules and the measurement of temperatures behind the shock front associated with the HI expanding shells will be done. Enough Southern 21cm line data, taken by astronomers at the Instituto Argentino de Radioastronomia in collaboration with Dr. Heiles, have been obtained to present the first preliminary analysis of the interstellar medium in the Southern sky. The Southern data will be completed and combined with the Northern data to form a complete, unified sky survey.

The first Zeeman studies of the 21cm line seen in emission have begun. In addition to a number of tantalizing results which need further work, detection of large magnetic fields at seven positions in the Orion region will be completed. Zeeman studies of recombination lines in high-density regions where the field should be large will be continued.

SUPPORTED BY U.S. Natl. Science Foundation

**10.0004, AEROSOL EFFECTS ON ATMOSPHERIC HEATING AND THE UTILITY OF SETI SYSTEMS FOR RADIOASTRONOMY**
*W.J. WELCH*, Univ. of California, School of Engineering, *Berkeley, California* 94720 (NCA 2-50702)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**10.0005, EXPERIMENTAL STUDY OF MARTIAN CARBONATE FORMATION**
*H.H. KIEFFER*, Univ. of California, Inst. of Geophys. & Pla. Phys., *Los Angeles, California* 90024 (NSG 7282)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**10.0006, OBSERVATIONS OF HOT WHITE DWARFS FROM SAS-3**
*B.H. MARGON*, Univ. of California, Graduate School, *Los Angeles, California* 90024 (NSG 5149)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**10.0007, SPECTROSCOPY OF COSMIC X-RAY SOURCES OF THE SOLAR CORONA**
*A.B. WALKER*, Stanford University, School of Hum. & Sciences, *Palo Alto, California* 94305 (NSG 5131)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**10.0008, DEVELOPMENT OF A 200 CHANNEL PHOTOMETER FOR USE IN LOW LIGHT LEVEL ASTRONOMY**
*C.E. MCILWAIN*, Univ. of California, Graduate School, *San Diego, California* 92037 (NASW 2996)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**10.0009, STUDY OF MASS FLOW IN THE MASSIVE SPECTROSCOPIC BINARY**
*M.J. BARLOW*, Univ. of Colorado, Graduate School, *Boulder, Colorado* 80302 (NSG 5147)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**10.0010, A SPECTROSCOPIC STUDY OF O TYPE STARS**
*P.S. CONTI*, Univ. of Colorado, School of Arts & Sciences, *Boulder, Colorado* 80302 (AST76-20842)

A program of spectroscopic research will be carried out on the O type stars. As a class, these are the most massive of all stars. Their very high temperatures and luminosities make them useful objects in which to study complex physical phenomena. Since even a very massive star can pour out energy at a high rate for only a short time, these stars must be very young on a cosmic time scale. By virtue of the enormous quantity of radiation that they emit, the O stars influence directly the immediate stellar neighborhood in which they reside. Therefore, their presence is important for the formation and early evolution of other nearby stars. In the last few years, astronomers have come to realize that all O type stars lose mass. Indeed, for the hottest and most luminous stars, the gas flows out at such a rate that the outer atmosphere of the star is substantially modified. This so- called 'stellar wind' not only influences the immediate vicinity of the star but also substantially affects the subsequent evolution of the O-type star itself. Conti plans two lines of attack: 1) He will study phenomena present in the stellar winds as evidenced by the emission and absorption line profiles taken from the O stars spectra. 2) He will determine stellar masses via investigations of O-type binary star systems.

SUPPORTED BY U.S. Natl. Science Foundation

**10.0011, AE-E BACKSCATTER ULTRAVIOLET EXPERIMENT - SHORT-TERM DATA REDUCTION AND ANALYSIS**
*A.I. STEWART*, Univ. of Colorado, Graduate School, *Boulder, Colorado* 80302 (NAS 5-23808)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**10.0012, ULTRAVIOLET STUDIES OF HEAVY-ELEMENT ABUNDANCES IN STARS**
*H.L. SHIPMAN*, Univ. of Delaware, Graduate School, *Newark, Delaware* 19711 (NSG 5144)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**10.0013, FORM CLASSIFICATION OF STELLAR SPECTRA, GALAXIES, AND CLUSTERS OF GALAXIES**
*W.W. MORGAN*, Univ. of Chicago, Graduate School, *Chicago, Illinois* 60637 (AST76-21710)

This research will include the following projects: 1) A revised MK spectral atlas will be completed for stars hotter than the sun. This includes: (a) continued development of the conceptual framework underlying the MK spectral classfication system itself; (b) the preparation of the remaining photographic masters and the completion of fifty photographic sets of the forty-plate atlas. 2) A catalogue of spectral types, based on the revised MK atlas, will be prepared. The catalogue will furnish two-dimensional spectral types of a precision never before achieved. This will result in more accurate spectroscopic luminosities and distances, and in the recognition and description of a number of peculiar spectroscopic categories not recognized earlier. 3) A survey will be completed for discovery of new, weak, galaxy clusters containing supergiant CD galaxies.

SUPPORTED BY U.S. Natl. Science Foundation

**10.0014, MAGNETOSPHERIC AND INTERPLANETARY INVESTIGATIONS BASED ON DATA FROM INSTRUMENTS ON THE MARINER-10 MISSION TO MARS**
*J.A. SIMPSON*, Univ. of Chicago, Graduate School, *Chicago, Illinois* 60637 (NSG 7288)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**10.0015, THEORY OF INTERSTELLAR MEDIUM**
*W.D. WATSON*, Univ. of Illinois, School of Liberal Arts & Sci., *Urbana, Illinois* 61801 (AST73-04781 A01)

Research on the theory of the interstellar medium with an emphasis toward the basic atomic, molecular, and solid-state processes will be carried out. Topics for investigation include isotope fractionation in molecules, atomic and molecular reactions, charge-exchange among atoms, processes relevant to determining the source for heating the interstellar gas, sticking of dust grains in collisions and the kinetics of surface reactions. Close interaction with physicists and chemists in relevant research areas, as well as with observers, will be emphasized.

SUPPORTED BY U.S. Natl. Science Foundation

**10.0016, PIONEER VENUS PROBE MODELS INSTRUMENTED DROP TESTS**
*UNKNOWN*, Univ. of Kansas, Graduate School, *Lawrence, Kansas* 66044 (NAS 2-9414)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**10.0017, STELLAR ASTROPHYSICS**
*W.K. ROSE*, Univ. of Maryland, School of Arts & Sciences, *College Park, Maryland* 20742 (AST76-17608)

This proposal outlines a theoretical investigation of stellar astrophysics. About two-thirds of the effort will be directed toward plasma astrophysics as applied to pulsars and matter in the vicinity of compact stars. The remainder of the proposal is for a theoretical investigation of stellar evolution and nucleosynthesis in red giants that are the likely progenitors of pulsars. Compact objects in close binary star systems also will be studied. The plasma astrophysics application will include work on the origin of magnetic fields and acceleration mechanisms for charged particles. Nonlinear effects such as solitons will be included. The research on the physical properties of the progenitors of pulsars will include a study of dynamic effects and nucleosynthesis in stars of intermediate mass. Studies will be made of the nova outburst, including problems associated with compact objects as they become defined by developments in X-ray astronomy.

SUPPORTED BY U.S. Natl. Science Foundation

**10.0018, MINEROLOGY OF THE SURFACES OF MERCURY AND MARS**
*T.B. MCCORD*, Mass. Inst. of Technology, School of Science, *Cambridge, Massachusetts* 02139 (NSG 7273)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**10.0019, RADIO ASTRONOMY AT THE HAYSTACK OBSERVATORY**
*P.B. SEBRING*, Northeast Radio Observ. Corp., *Westford, Massachusetts* 01886 (AST75-14701 A01)

The Haystack Observatory will continue to provide a fine radio astronomy observing facility available to all U.S. astronomers and easily accessible to the groups based in New England. Research in the coming year will center around continuing programs aimed at understanding the characteristics of molecules found in interstellar space and their relationship to clouds of dust and hydrogen gas out of which stars are being formed. Particular attention will be paid to the water, methanol, and ammonia molecules. Silicon monoxide and water vapor have been found to be associated with very large, but very cool stars. The nature of this association will be investigated.

Finally, considerable effort will be spent on Very Long Baseline Interferometry - a series of worldwide cooperative projects providing the highest resolution and most accurate positional measurements in astronomy. Such measures indicate the existence of apparent velocities greater than the speed of light in certain quasars. About one-fourth of the telescope time will be spent on this type of observation.

This is a continuation of support under NSF grant AST 75-14701.

SUPPORTED BY U.S. Natl. Science Foundation

**10.0020, SEARCH FOR HOT SPOTS AT THE FOOT OF IO-ASSOCIATED FLUX TUBE IN JUPITER**
*S.K. ATREYA*, Univ. of Michigan, Graduate School, *Ann Arbor, Michigan* 48104 (NSG 5139)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**10.0021, HALOGEN OCCULTATION EXPERIMENT PHASES I AND II**
*S.R. DRAYSON*, Univ. of Michigan, School of Engineering, *Ann Arbor, Michigan* 48106 (NSG 1373)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**10.0022, STUDY DIRECTED TOWARDS IDENTIFICATION OF SOLAR PROTON FLARES**
*O.C. MOHLER*, Univ. of Michigan, School of Lit. Sci. & the Arts, *Ann Arbor, Michigan* 48104 (DF247950; F19628-76-C-0240)

AF function - communications and surveillance. Deficiency - inability to accurately predict geophysically significant proton-releasing solaf flares. Objective - to obtain reliable association between significant proton events measured at the earth and associated solar phenomena and other related phenomena. How research contributes - identification of solar flares and other associated solar-terrestrial phenomena with significant proton events measured at the earth will assist in the in-house research efforts directed towards the prediction of solar and solar-terrestrial disturbances that affect the near-earth environment in which USAF systems operate.

The available solar observational data combined with the unique solar-terrestrial data records maintained at the McMath-Hulbert Observatory will be utilized for the identification of solar and geophysical phenomena associated with earth-sensed solar proton events between 1970 and 1976.

ADDENDA: Supporting agency address is: AF Geophysics Laboratory PH L.G. Hanscom AFB, Bedford, Mass 01730

SUPPORTED BY U.S. Dept. of Defense - Air Force

**10.0023, PETROLOGIC STUDY OF RETURNED LUNAR SAMPLES**
*P.W. WEIBLEN*, Univ. of Minnesota, School of Earth Sciences, *Minneapolis, Minnesota* 55455 (NSG 9050)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**10.0024, TRANSPORT PROPERTIES IN THE ATMOSPHERE OF JUPITER**
*L. BIOLSI*, Univ. of Missouri, Graduate School, *Rolla, Missouri* 65401 (NSG 1369)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**10.0025, OBSERVATIONS OF ULTRAVIOLET EMISSION LINES IN GASEOUS NEBULAE**
*R.D. SCHWARTZ*, Univ. of Missouri, Graduate School, *St. Louis, Missouri* 63121 (NSG 5151)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**10.0026, HARDWARE PHASE OF THE SOLAR GAMMA-RAY EXPERIMENT FOR THE SOLAR MAXIMUM MISSION**
*UNKNOWN*, Univ. of New Hampshire, Graduate School, *Durham, New Hampshire* 03824 (NAS 5-23761)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**10.0027, CONDENSED MATTER IN ASTROPHYSICS**
*R. SMOLUCHOWSKI*, Princeton University, School of Engin. & Appl. Sci., *Princeton, New Jersey* 08540 (NSG 7283)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**10.0028, NUCLEAR ASTROPHYSICS AND NUCLEAR STRUCTURE PHYSICS**
*C.C. TRAIL*, City University of New York, School of Science, *Brooklyn, New York* 11210 (PHY75-20617)

The research utilizes an accelerator capable of producing beams of high-current proton, helium, or heavy-ion particles.

The energy dependence of nuclear reactions involved in stellar burning processes will be investigated. Accurate data are necessary to understand stellar energy production. Heavy-ion reactions (e.g., 12C plus 12C), as well as capture reactions between protons or alpha particles and nuclei present in stellar interiors will be studied.

The dynamics of the fissioning of heavy nuclei will also be examined using gamma rays to induce fission. Large numbers of (mono- energetic) gamma rays will be obtained from resonance reactions of accelerated protons with appropriate nuclear targets.

SUPPORTED BY U.S. Natl. Science Foundation

**10.0029, DYNAMICAL STUDIES OF PLANETARY SATELLITES - CAPTURE OF THE OUTER JOVIAN SATELLITES AND THE TIDAL ACCELERATION OF PHOBOS**
*J.A. BURNS*, Cornell University, School of Engineering, *Ithaca, New York* 14850 (NCA 2-175701)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**10.0030, MODELS FOR ALLOCATIONS IN ASTRONOMY AND OTHER SCIENCES**
*M.O. HARWIT*, Cornell University, School of Arts & Sciences, *Ithaca, New York* 14853 (SOC75-15804)

Professor Harwit has succeeded in constructing an ordered space each point of which corresponds to a different astronomical observation. This space is found to be finite and bounded at least for observations using electromagnetic waves -- which constitute the build of current observations. In terms of this ordered space, an objective definition has been set up to decide what constitutes observation of a new 'phenomenon. I.) This has allowed a comparison of the rates of implementation of new observational techniques and the rate of discovery of new phenomena in astronomy. II.) Through the use of certain rather general assumptions he is also led to a rough estimate of the total number of phenomena that still remains to be discovered in astronomy. Both these criteria are potentially useful in planning the allotment of resources to a given branch of science. Professor Harwit is continuing his study to determine the following: 1. Whether the space describing all possible astronomical observations also is bounded, and whether general bounds exist that could also keep the set of all possible observations finite in other branches of science. 2. Whether his model is stable against small perturbations in the definition of what constitutes a 'phenomenon'. 3. Whether currently practical steps exist that would permit a computer search of the astronomical literature to provide more reliable input data for his model than the (probably somewhat biased) personal literature search conducted to date.

SUPPORTED BY U.S. Natl. Science Foundation

**10.0031, INFRARED SPECTROSCOPY OF JUPITER AND SATURN**
*R.F. KNACKE*, State University of New York, School of Arts & Sciences, *Stony Brook, New York* 11790 (NSG 7286)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**10.0032, RELATIVE ROTATIONAL BROADENING OF FAR ULTRAVIOLET SPECTRAL LINES**
*G.W. COLLINS*, Ohio State University, School of Math. & Phys. Scis., *Columbus, Ohio* 43210 (NSG 5140)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**10.0033, A SEARCH FOR VARIATIONS IN THE SPECTRUM OF GAMMA GAS**
*A. SLETTEBAK*, Ohio State University, School of Math. & Phys. Scis., *Columbus, Ohio* 43210 (NSG 5141)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**10.0034, EVOLUTION AND DYNAMICS OF EXPLODING STARS**
*J.C. WHEELER*, Univ. of Texas, School of Natural Sciences, *Austin, Texas* 78712 (AST76-07629)

The phases immediately following the onset of carbon ignition in the cores of intermediate-mass stars will be studied in detail. The goal will be to verify preliminary calculations which indicate that carbon ignition can not spontaneously lead to a supernova explosion in such stars. If this turns out to be the case, this research will require a revision of concepts on the final evolution of intermediate- mass stars and indicate means by which these stars can create a supernova explosion and leave behind a neutron star remnant. The physics of the neutrino transport process, which may be the underlying mechanism causing a supernova explosion, will be examined. The evolution of very massive stars will be explored to determine whether the endpoint of such a star will be a massive black hole. Such black holes have been postulated as the source of the recently discovered X- ray emission from globular clusters.

SUPPORTED BY U.S. Natl. Science Foundation

**10.0035, LABORATORY INVESTIGATION OF ATMOSPHERIC COLLISION PROCESSES**
*R.F. STEBBINGS*, Rice University, Graduate School, *Houston, Texas* 77001 (ATM76-24423)

This grant funds laboratory studies of atomic collision processes occurring in the atmospheres of earth and other planets. The principal emphasis is on ion-molecule reactions in

the energy range from 0.05 to 200 eV, with a secondary program in the use of lasers, both for studies of photon interaction with atmospheric species, and as a diagnostic tool for detecting and identifying metastable particles and assessing their role in collisional processes. This work will provide data on a variety of atomic collision phenomena and will use those data to interpret more fully the structure, composition, and behavior of the atmosphere of earth and the other planets.

SUPPORTED BY U.S. Natl. Science Foundation

**10.0036, TRACE ELEMENTS IN PLANETARY MATERIAL BY ACTIVATION ANALYSIS**
*W.W. MORGAN*, Univ. of Texas, School of Medicine, *San Antonio, Texas* 78284 (NSG 9049)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**10.0037, SPECTROSCOPY AND THEORY OF HERBIG-HARO OBJECTS AND OF ATMOSPHERES OF WHITE DWARF STARS**
*K. BOHM*, Univ. of Washington, School of Arts & Sciences, *Seattle, Washington* 98105 (AST76-22262)

In order to contribute to our understanding of the processes occurring in the formation and early evolution of stars, spectroscopic and theoretical studies of Herbig-Haro and related objects will be carried out. The Herbig-Haro objects are believed to be stars in the very early stages of evolution. The time changes in physical conditions in these objects will be studied, and the metal abundances will be examined. A theoretical picture of the observed spectra will be developed based on the idea that the spectra of Herbig-Haro objects are formed in the cooling regions behind shock waves. Further spectrophotometric studies of the star R Monocerotis (a variable star which illuminates the variable nebula NGC 2261) will also be made. In order to obtain more information about the final cooling phases of the helium-rich white dwarf stars, studies will be made of the atmospheres and outer convection zones of extremely cool white dwarf stars. There will be a theoretical calculation and intercomparison made of the structure of the atmosphere of various types of these stars. The possible formation of coronae around white dwarf stars and the consequences of this theory on predictions of extreme ultraviolet and X- ray spectra will be examined.

SUPPORTED BY U.S. Natl. Science Foundation

**10.0038, CONVECTION IN STELLAR ATMOSPHERES**
*E. BOHMVITENSE*, Univ. of Washington, School of Arts & Sciences, *Seattle, Washington* 98105 (AST75-09750 A01)

Theoretical studies will be made of the efficiency of convective energy transport in stars. This will be done in order to obtain an improved theory of convection in stellar atmospheres. The theoretical work will focus on the problems of overshooting effects, horizontal radiative energy exchange in stellar surface layers, and on the temperature stratification in the rising and falling masses of gas. Once temperature stratification has been determined for the gas, the energy distribution of the radiation will be obtained and line profiles calculated. This will enable one to determine which lines of the spectrum best show the effects of temperature stratification. As a check, the details of these computations will be compared with solar observations. The energy distribution in stars with different rotational velocities will be studied in order to obtain information about the possible influence of rotation on the onset of convection. This work is a renewal of NSF grant AST 75-09750.

SUPPORTED BY U.S. Natl. Science Foundation

**10.0039, THE KINEMATICS AND IONIZATION OF THE GUM NEBULA**
*G. WALLERSTEIN*, Univ. of Washington, School of Arts & Sciences, *Seattle, Washington* 98105 (NSG 5142)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

**10.0040, THE KINEMATICS AND IONIZATION OF THE GUM NEBULA**
*G. WALLERSTEIN*, Univ. of Washington, School of Arts & Sciences, *Seattle, Washington* 98105 (NSG 5142)

SUPPORTED BY U.S. Natl. Aero. & Space Adm.

## GENERAL

**11.0001, STUDY, REVIEW, AND SUMMARY OF THE CHARACTERISTICS OF ADAPTIVE WORK GROUPS AND HOW THEIR QUALITIES ARE ACHIEVED**
*J. SIEBER*, Calif. State Univ. & Colleges, Graduate School, *Hayward, California* 94541 (NCA 2-290705)

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VOLUME 15 NUMBER 10/ MAY 23, 1977

# Scientific and Technical Aerospace Reports

*A Semimonthly Publication of the National Aeronautics and Space Administration*

## 01 AERONAUTICS (GENERAL)

**N77-18991*** + National Aeronautics and Space Administration, Washington, D.C.

**AERONAUTICAL ENGINEERING: A SPECIAL BIBLIOGRAPHY WITH INDEXES, SUPPLEMENT 80**

Feb. 1977 89 p

(NASA-SP-7037(80)) Avail: NTIS HC A05 CSCL 01A

This bibliography lists 277 reports, articles, and other documents introduced into the NASA scientific and technical information system in January 1977. Author

**N77-18992*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

**REVISED FORTRAN PROGRAM FOR CALCULATING VELOCITIES AND STREAMLINES ON THE HUB-SHROUD MIDCHANNEL STREAM SURFACE OF AN AXIAL-, RADIAL-, OR MIXED-FLOW TURBOMACHINE OR ANNULAR DUCT. 1: USER'S MANUAL**

Theodore Katsanis and William D. McNally Washington Mar. 1977 107 p refs Supersedes NASA-TN-D-7343; N73-26996

(NASA-TN-D-8430; E-8734) Avail: NTIS HC A06/MF A01 CSCL 01A

A FORTRAN 4 computer program was developed that obtains a detailed subsonic or shock-free transonic flow solution on the hub-shroud midchannel stream surface of a turbomachine. The blade row may be fixed or rotating, and the blades may be twisted and leaned. Flow may be axial, mixed, or radial. Upstream and downstream flow variables may vary from hub to shroud, and provision is made to correct for loss of stagnation pressure. The results include velocities, streamlines, and flow angles on the stream surface as well as approximate blade surface velocities. Subsonic solutions are obtained by a finite-difference, stream-function solution. Transonic solutions are obtained by a velocity-gradient method that uses information from a finite-difference, stream-function solution at a reduced mass flow. Author

**N77-18993*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

**FLIGHT TEST PILOT EVALUATION OF A DELAYED FLAP APPROACH PROCEDURE**

J. S. Bull, F. G. Edwards, J. D. Foster, D. M. Hegarty, and F. J. Drinkwater, III Feb. 1977 17 p refs

(NASA-TM-X-73198; A-6887) Avail: NTIS HC A02/MF A01 CSCL 01B

Using NASA's CV-990 aircraft, a delayed flap approach procedure was demonstrated to nine guest pilots from the air transport industry. Four demonstration flights and 37 approaches were conducted under VFR weather conditions. A limited pilot evaluation of the delayed flap procedure was obtained from pilot comments and from questionaires they completed. Pilot acceptability, pilot workload, and ATC compatibility were quantitatively rated. The delayed flap procedure was shown to be feasible, and suggestions for further development work were obtained. Author

**N77-18994#** Advisory Group for Aerospace Research and Development, Paris (France).

**AERODYNAMIC NOISE**

Jan. 1977 306 p refs Presented at the Von Karman Inst. Rhode St. Genese, Belgium, Dec. 1976

(AGARD-LS-80) Avail: NTIS HC A14/MF A01

An appraisal of aerodynamic noise concepts, theory, and experiments is given. Practical methods are given for the prediction, measurement, and reduction of external noise from aircraft. A bibliography of 171 abstracts is included. For individual titles, see N77-18995 through N77-19005.

**N77-18995#** Royal Aircraft Establishment, Farnborough (England). Aerodynamic Dept.

**INTRODUCTORY COMMENTS ON AERODYNAMIC NOISE CONSIDERATIONS IN AIRCRAFT DESIGN AND OPERATION** **c05**

John Williams *In* AGARD Aerodynamic Noise, Jan. 1977 10 p (For primary document see N77-18994 10-01)

Avail: NTIS HC A14/MF A01

Engine design, airframe design, aircraft flight performance, and engine/airframe aeroacoustic interference must be analyzed with a significant bias towards the reduction of noise annoyance on the ground caused by takeoff, landing, and other low altitude subsonic operations. The static specific thrust is discussed as a more comprehensive engine cycle parameter than the bypass ratio. Aerodynamic noise reduction in turbofan engines is explored. Author

**N77-18996#** Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Berlin (West Germany). Institut fuer Turbulenzforschung.

**BASIC AERODYNAMIC NOISE THEORY** **c71**

Helmut V. Fuchs *In* AGARD Aerodynamic Noise, Jan. 1977 26 p refs (For primary document see N77-18994 10-01)

Avail: NTIS HC A14/MF A01

The identification of and physical and analytical modeling of the major sound sources associated with turbulent airflows are discussed. Deficiencies of existing theories with respect to the turbulent source models used are revealed. The importance of source coherency with regard to flow inhomogeneities is outlined. The relevance of studies in sound propagation from acoustic singularities embedded in a sheared flow is explored with respect to the jet noise problem. Author

**N77-18997#** Southampton Univ. (England). Institute of Sound and Vibration Research.

**JET NOISE** **c07**

M. J. Fisher and C. L. Morfey *In* AGARD Aerodynamic Noise, Jan. 1977 23 p refs (For primary document see N77-18994 10-01)

Avail: NTIS HC A14/MF A01

Total noise is composed of several components which must be considered separately. The most fundamental of these, and the most difficult to eliminate is jet mixing noise. In incorrectly

expanded jet exhaust flows, the presence of resulting shock waves leads to a set of discrete tones referred to as screech, together with a more broad band radiation. The advent of high bypass ratio, relatively low jet efflux velocity engines reveals additional sources of noise, variously referred to as excess noise, tailpipe noise, or core noise. Each of the noise components is reviewed for consideration in determining whether the shock associated noise is generated within the engine or originates as the result of interaction between vorticity and the nozzle termination.
Author

**N77-18998#** Rolls-Royce Ltd., Derby (England).
**GAS TURBINE ENGINE EXHAUST NOISE** **c07**
Kenneth W. Bushell *In* AGARD Aerodynamic Noise, Jan. 1977 35 p refs (For primary document see N77-18994 10-01)
Avail: NTIS HC A14/MF A01

The sources of noise which emanates from the exhaust of a gas turbine engine are reviewed. The most important of these are considered to be associated with the combustion system, the turbine, the exhaust system, obstructions, and turbulence/noise interaction with the jet structure. Also considered is the jet mixing noise due to single and coaxial streams. Prediction methods for these sources are given and reviewed. Reflections from the ground are also discussed because of the influence these can have in the lower frequency part of the spectrum. The effects of flight or forward speed on these noise sources are considered.
Author

**N77-18999#** Rolls-Royce Ltd., Derby (England).
**FAN NOISE** **c07**
B. W. Lowrie *In* AGARD Aerodynamic Noise, Jan. 1977 21 p refs (For primary document see N77-18994 10-01)
Avail: NTIS HC A14/MF A01

Spectral and radiative properties of aeroengine fan-generated noise are described statistically and, wherever possible, in flight. Basic concepts and theoretical approaches are considered, including dimensional analysis and features of the sources deduced. It is found that fans produce both tonal and random noise. While the sources of the tonal noise are several, they can be defined quite specifically, and consist in the main of regular lift fluctuations created on individual blades by inflowing distortions. For the exceptional case of supersonic relative velocity the tonal noise is dominated by the steady pressure field relative to the blade row becoming, at high supersonic speeds, a shockwave-expansion pattern. The significant sources of broad band noise are less well defined but could be produced equally well by self-excited phenomena on blade rows as by fluctuations in the inflowing airstream.
Author

**N77-19000*#** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
**AIRPLANE SELF-NOISE - FOUR YEARS OF RESEARCH** **c71**
Jay C. Hardin *In* AGARD Aerodynamic Noise, Jan. 1977 19 p refs (For primary document see N77-18994 10-01)
Avail: NTIS HC A14/MF A01

A critical assessment of the state of the art in airframe self-noise is presented. Full-scale data on the intensity, spectra, and directivity of this noise source are evaluated. Vibration of panels on the aircraft is identified as a possible additional source of airframe noise. The present understanding and methods for prediction of other component sources (airfoils, struts, and cavities) are discussed, and areas for further research as well as potential methods for airframe noise reduction are identified. Various experimental methods which have been developed for airframe noise research are discussed, and sample results are presented.
Author

**N77-19001#** Southampton Univ. (England). Institute for Sound and Vibration Research.
**AERO-ACOUSTIC MEASUREMENT AND ANALYSIS TECHNIQUES** **c71**
Michael E. House *In* AGARD Aerodynamic Noise, Jan. 1977 48 p refs (For primary document see N77-18994 10-01)
Avail: NTIS HC A14/MF A01

The main source characteristics for aerodynamically generated multipoles are summarized. Information theory is applied with respect to data acquisition rates, signal information, and transformations. Data collection, test environment, instrumentation, storage and display, signal analysis, and specialized measurement techniques are discussed.
Author

**N77-19002#** Southampton Univ. (England). Inst. for Sound and Vibration Research.
**AIRCRAFT FLYOVER MEASUREMENTS** **c07**
Michael E. House *In* AGARD Aerodynamic Noise, Jan. 1977 14 p refs (For primary document see N77-18994 10-01)
Avail: NTIS HC A14/MF A01

Influences of in-flight conditions on aircraft engine noise are discussed. Topics include engine cycle conditions, intake flow, aircraft and nacelle aerodynamic flow, convected motion effects, Doppler source-to-receiver effects, aircraft attitudinal and atmospheric or ground propagation effects. The aircraft's relative motion must be determined and tracked to the measuring position on the ground.
Author

**N77-19003#** Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
**COMPARISON OF DIFFERENT METHODS OF LOCALISATION AND IDENTIFICATION OF NOISE SOURCES IN TURBOJET ENGINES [COMPARISON DE DIFFERENTES METHODS DE LOCALISATION ET D'IDENTIFICATION DE SOURCES SONORES DE TURBOREACTEURS]** **c07**
Mariano Perulli *In* AGARD Aerodynamic Noise, Jan. 1977 13 p refs In FRENCH (For primary document see N77-18994 10-01)
Avail: NTIS HC A14/MF A01

Techniques developed for measuring and processing the signals from turbojet engine noise are discussed. Special emphasis is given to those concerned with measuring near and far pressure fields. The source media is characterized, and a virtual distribution of noise sources is furnished. In rare cases, these investigations lead to a real distribution of the noise sources. Trans. by A.R.H.

**N77-19004#** Royal Aircraft Establishment, Farnborough (England).
**GROUND-BASED FACILITIES WITH FORWARD-SPEED REPRESENTATION FOR AIRCRAFT NOISE RESEARCH** **c09**
John Williams *In* AGARD Aerodynamic Noise, Jan. 1977 43 p refs (For primary document see N77-18994 10-01)
Avail: NTIS HC A14/MF A01

The special merits, deficiencies, and problem areas arising with several particular types of ground based facilities are analyzed and quantified in basic practical terms. The complementary usage of more than one facility type is shown to be desirable to ensure checks on each other, and to widen the range of experiments possible. Topics discussed include: (1) subsonic windtunnel development and operation for noise testing; (2) special factors in acoustic tunnel design and application; (3) tracked vehicle development and operation for noise model testing; (4) other mobile ground based facilities for noise testing; and (5) model scale simulation of propulsion and powered lift noise sources.
Author

**N77-19005#** Advisory Group for Aerospace Research and Development, Paris (France).
**A BIBLIOGRAPHY OF SELECTED LITERATURE PUBLISHED BETWEEN 1973 AND 1976 WITH EMPHASIS ON EXPERIMENTAL STUDIES** **c82**
*In its* Aerodynamic Noise, Jan. 1977 46 p refs (For primary document see N77-18994 10-01)
Avail: NTIS HC A14/MF A01

One hundred seventy-one abstracts are presented from Scientific and Technical Aerospace Reports (STAR) and from International Aerospace Abstracts (IAA). Categories are: (1) aerodynamic sound (general reviews); (2) measurement techniques; (3) jet noise; (4) noise associated with lift augmentation devices; (5) airframe noise; (6) fan noise; and (7) noise prediction.
A.H.

# 02 AERODYNAMICS

Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery.

For related information see also *34 Fluid Mechanics and Heat Transfer.*

**N77-19006*#** Michigan State Univ., East Lansing. Dept. of Mechanical Engineering.

**THE EFFECTS OF THE LAMINAR/TURBULENT BOUNDARY LAYER STATES ON THE DEVELOPMENT OF A PLANE MIXING LAYER Final Report**

J. F. Foss 27 Feb. 1977 29 p refs

(Grant NsG-1138)

(NASA-CR-149798) Avail: NTIS HC A03/MF A01 CSCL 01A

The effect of the laminar/turbulent boundary layer state on the mean and rms velocities of a developing plane mixing layer was investigated. The use of commonly accepted nondimensional representations of the data confirm (at least) an approximately self-preserving condition. It is suggested that the effects of the laminar/turbulent initial condition persist in the self-preserving region. Author

DATA SUMMARY: The developing region of a plane mixing layer for the two distinct initial conditions: a laminar and a turbulent boundary layer at x = 0 are documented; variables include velocity flunctuation, flow distribution, layer thickness, turbulence, and momentum; 11 figures and 33 tables include numeric data.

**N77-19007*#** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

**APPARATUS FOR EXPERIMENTAL INVESTIGATION OF AERODYNAMIC RADIATION WITH ABSORPTION BY ABLATION PRODUCTS**

William L. Wells and Walter L. Snow Washington Mar. 1977 47 p refs

(NASA-TM-X-3467; L-11168) Avail: NTIS HC A03/MF A01 CSCL 20D

A description is given and calibration procedures are presented for an apparatus that is used to simulate aerodynamic radiant heating during planetary entry. The primary function of the apparatus is to simulate the spectral distribution of shock layer radiation and to determine absorption effects of simulated ablation products which are injected into the stagnation region flow field. An electric arc heater is used to heat gas mixtures that represent the planetary atmospheres of interest. Spectral measurements are made with a vacuum ultraviolet scanning monochromator. Author

DATA SUMMARY: Diverse data are presented; variables include wavelength, electron number density, upper state number density, temperature, continuum emission coefficient, spectral intensity, photon energy, optical efficiency, relative fluorescent emission probability.

**N77-19008*#** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

**WIND TUNNEL INVESTIGATION OF AN UNPOWERED HELICOPTER FUSELAGE MODEL WITH A V-TYPE EMPENNAGE**

Carl E. Freeman and William T. Yeager, Jr. Washington Mar. 1977 54 p refs Prepared in cooperation with Army Air Mobility R and D Lab., Hampton, Va.

(DA Proj. 1L2-62209-AH-76)

(NASA-TM-X-3476; L-11273) Avail: NTIS HC A04/MF A01 CSCL 01A

The applicability of a V-type empennage on an unpowered semiscale helicopter fuselage is considered as design criteria for improved directional control devices. Configuration changes included variations of V-tail dihedral angle, planform area, and incidence angle. Of the configurations tested, a V-tail with a dihedral angle of 55 deg, a total planform area of 0.244 sq cm, and an incidence angle of 5 deg most nearly match the trim and static stability of the baseline conventional empennage. Author

DATA SUMMARY: Design optimization of empennage configuration for helicopter stability and control at cruise speed; the variables include dimensions, angle of attack, longitudinal characteristics, planform, fuselage, and lateral directional characteristics; 10 figures and no tables.

**N77-19009*#** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

**LATERAL AERODYNAMIC PARAMETERS EXTRACTED FROM FLIGHT DATA FOR THE F-8C AIRPLANE IN MANEUVERING FLIGHT**

William T. Suit Washington Mar. 1977 46 p refs

(NASA-TN-D-8276; L-10742) Avail: NTIS HC A03/MF A01 CSCL 01A

Flight test data are used to extract the lateral aerodynamic parameters of the F-8C airplane at moderate to high angles of attack. The data were obtained during perturbations of the airplane from steady turns with trim normal accelerations from 1.5g to 3.0g. The angle-of-attack variation from trim was negligible. The aerodynamic coefficients extracted from flight data were compared with several other sets of coefficients, and the extracted coefficients resulted in characteristics for the Dutch roll mode (at the highest angles of attack) similar to those of a set of coefficients that have been the basis of several simulations of the F-8C. Author

DATA SUMMARY: Iterative determination of aerodynamic derivatives from flight test data obtained near trim at Mach numbers of 0.7 and 0.8; the variables include flight conditions, instrument ranges, estimated standard deviations, aerodynamic parameter correlation, damping ratios, time histories, aileron input, and rudder input; 9 figures and 8 tables.

**N77-19010*#** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

**EFFECT OF NONLIFTING EMPENNAGE SURFACES ON SINGLE-ENGINE AFTERBODY/NOZZLE DRAG AT MACH NUMBERS FROM 0.5 TO 2.2**

Bobby L. Berrier Washington Feb. 1977 183 p refs

(NASA-TN-D-8326; L-11014) Avail: NTIS HC A09/MF A01 CSCL 01A

The effect of empennage interference on the drag characteristics of a model with a single engine fighter aft end with convergent-divergent nozzles was studied. The dry and maximum afterburning nozzle power settings were investigated. A high pressure air system was used to provide jet total pressure ratios up to 20.0. In an attempt to quantify and reduce adverse empennage interference and decrease aft-end drag, several empennage arrangements (variable tail surface location), contour bump configurations, and locally contoured afterbodies were investigated. The results of the investigation indicate that empennage interference effects can be significant at transonic and supersonic speeds. The most effective means of reducing adverse empennage interference is the proper relocation of individual tail surfaces. The aft or conventional empennage arrangement produced the highest aft-end drag at all conditions investigated. Author

DATA SUMMARY: Diverse data are presented; variables include drag coefficient, jet pressure ratio, static pressure coefficient, axial distance/model length, free stream Mach number, area, tail height, taper ratio, aspect ratio.

**N77-19011#** Sandia Labs., Livermore, Calif. Advanced Mechanical Div.

**B77 FLIGHT TEST DATA PROCESSING**

R. E. Humphrey and E. D. Holbrook Jul. 1976 59 p

(Contract E(29-1)-789)

(SAND-76-8010) Avail: NTIS HC A04/MF A01

A system of equations which can be used to obtain aerodynamic forces and moments, angles of attack and sideslip, and aerodynamic coefficients from flight test data obtained from the B77 flight test program is presented. ERA

DATA SUMMARY: No numeric data are presented.

**N77-19012#** Royal Aircraft Establishment, Farnborough (England). Aerodynamics Dept.
**SOME SERIES-EXPANSION SOLUTIONS FOR SLENDER WINGS WITH LEADING-EDGE SEPARATION**
R. W. Clark, J. H. B. Smith, and C. W. Thompson London Aeron. Res. Council 1976 57 p refs Supersedes RAE-TR-75004; ARC-36059
(ARC-R/M-3785; RAE-TR-75004; ARC-36059) Avail: NTIS HC A04/MF A01; HMSO £4.30; PHI $16.67

The vortices formed above each leading edge of the wing were represented by a line vortex, as in the treatment of the flat delta wing by Brown and Michael, and the slender-body approximation was made. Four problems are treated: the thick, conical delta wing with rhombic cross-sections; the thick, conically-cambered delta wing formed by one-half of a circular cone; the flat-plate wing with curved leading edges; and a wing with a partially swept leading edge and lengthwise camber. The quantities of interest are the position of the vortex and its circulation, and the nonlinear lift and pitching moment of the wing. In each problem the solution is presented as an asymptotic series in a small parameter representing the scale of the separation. The solutions are used to shed light on a number of problems arising in the aerodynamics of slender wings. Author (ESA)

DATA SUMMARY: Line vortex model for leading edge flow separation; the variables include wing cross section, vortex position, lift coefficient, aerodynamic lift, pressure distribution, vortex strength, and wing planforms; 8 figures and no tables.

**N77-19013#** Royal Aircraft Establishment, Farnborough (England). Aerodynamics Dept.
**PLANAR INCOMPRESSIBLE FLOW OVER AN AEROFOIL AND ITS WAKE**
F. T. Smith London Aeron. Res. Council 1976 39 p refs Supersedes RAE-TR-74169; ARC-36115
(ARC-CP-1352; RAE-TR-74169; ARC-36115) Avail: NTIS HC A03/MF A01; HMSO£1.60; PHI $6.25

A method for obtaining the incompressible flow over a given two-dimensional airfoil at incidence, in which the rigid body and its boundary layer and wake are considered as forming a single semi-infinite body past which the inviscid fluid flows, is described. The objective is to enable the viscous effects to be accommodated directly into an inviscid calculation, particularly near the sharp trailing-edge, where the singular point is in reality smoothed over by the boundary layer, and in the thin wake, the shape of which has to be determined. By a conformal mapping to a halfplane an iterative cycle was set up to compute the solution, each iteration starting with a given shape, from which velocities are found, and ending with a suitable new guess for the wake shape, subject to certain conditions on the pressure and slope discontinuities across the wake. Results are presented for a Karman-Trefftz section of medium camber, both in the inviscid limit of zero displacement thickness (in which there is very good agreement with the exact solution) and for small nonzero displacement thicknesses near the trailing edge and in the wake. The method should be applicable to further problems.
Author (ESA)

DATA SUMMARY: Conformal mapping for calculating two dimensional flow field; the variables include flow distribution, aerodynamic configuration, trailing edge, wing profile, aerodynamic coefficient, wakeflow, pressure distribution, and incidence; 8 figures and no tables.

**N77-19014#** Royal Aircraft Establishment, Farnborough (England). Structures Dept.
**WIND TUNNEL FLUTTER TESTS AT SUBSONIC SPEEDS ON A HALF-WING WITH A FAN ENGINE NACELLE**
D. A. Drane and G. B. Hutton London Aeron. Res. Council 1976 38 p refs Supersedes RAE-TR-74130; ARC-35955
(ARC-CP-1354; RAE-TR-74130; ARC-35955) Avail: NTIS HC A03/MF A01; HMSO £1.80; PHI $7.20

Flutter tests were made on a half-wing model with a fan-engine nacelle attached by a pylon at an inboard section. The model was nominally rigid, and flexibilities in pitch and roll were introduced at the root. Measurements were made of the flutter characteristics of the model at Mach numbers of 0.6 and 0.8 over a range of dynamic pressures using three different methods of analysis. The nacelle was replaced by a narrow pencil of equivalent inertia in order to assess the effects on the flutter characteristics of the aerodynamic forces on the nacelle. It is shown that these forces modify significantly the aeroelastic behavior of the wing-nacelle system. The tests were made in conjunction with the Office National d'Etudes et de Recherches Aerospatiales and were part of a larger investigation which included static and oscillatory pressure measurements on the wing. Author (ESA)

DATA SUMMARY: Subcritical response measurements on half-wing model with large nacelle; the variables include modal frequencies, damping ratios, Mach number, wing planform, frequency response, and aerodynamic forces; 13 figures and no tables

**N77-19015#** Royal Aircraft Establishment, Farnborough (England). Structures Dept.
**THE FLUTTER OF A TWO-DIMENSIONAL WING WITH SIMPLE AERODYNAMICS**
T. Niblett London Aeron. Res. Council 1976 35 p refs Supersedes RAE-TR-75008; ARC-36164
(ARC-CP-1355; RAE-TR-75008; ARC-36164) Avail: NTIS HC A03/MF A01; HMSO £1.60; PHI $6.25

The flutter stability of a rigid wing with two degrees-of-freedom and subject to the simplest aerodynamic forces including damping was considered. The limits of combinations of nodal axis positions which can lead to flutter were found, and a fairly simple expression from which the flutter speed can be found is given. The results are compared with those from simple frequency-coalescence theory. The comparison shows that the present theory indicates that flutter will occur more extensively than indicated by frequency-coalescence theory both in terms of nodal axis combinations and range of airspeed. Author (ESA)

DATA SUMMARY: Aeroelastic analysis on two dimensional wing using countour plots to determine flutter stiffness; the variables include aerodynamic coordinates, stable oscillation, nonstabilized oscillation, damping, pitch (inclination), trailing edges, leading edges, and stiffness; 14 figures and no tables.

**N77-19016#** Royal Aircraft Establishment, Farnborough (England). Structures Dept.
**AN APPLICATION OF FAST FREQUENCY-SWEEP EXCITATION TO THE MEASUREMENT OF SUB-CRITICAL RESPONSE OF A LOW SPEED WIND TUNNEL MODEL**
C. W. Skingle and D. R. Gaukroger London Aeron. Res. Council 1976 28 p. refs Supersedes RAE-TR-74129; ARC-36184
(ARC-CP-1356; RAE-TR-74129; ARC-36184) Avail: NTIS HC A03/MF A01; HMSO £1.50; PHI $5.80

An analysis method was developed to enable modal frequencies and damping ratios of a system to be obtained from excitation and response records in conditions where the system is also excited by unknown random forces. The transient input was a fast frequency-sweep, and the resulting response and force input records were processed using digital Fourier analysis techniques. The results are compared with those obtained from sustained sinusoidal excitation. Comparisons are given for the frequency and damping characteristics of the first four modes of the model. Frequencies are in reasonable agreement between the two sets of results, but the high degree of scatter in the values of damping ratio makes detailed comparison difficult.
Author (ESA)

DATA SUMMARY: Fourier analysis techniques for flutter analysis on swept wing models; the variables include wing profiles, modal frequency, airspeed, damping ratio, flutter margin, and flutter speed; 7 figures and 2 tables.

**N77-19017#** Royal Aircraft Establishment, Farnborough (England). Aerodynamics Dept.
**A PRACTICAL APPROACH TO THE PREDICTION OF OSCILLATORY PRESSURE DISTRIBUTIONS ON WINGS IN SUPERCRITICAL FLOW**
H. C. Garner London Aeron. Res. Council 1976 61 p refs Supersedes RAE-TR-74181; ARC-36100
(ARC-CP-1358; RAE-TR-74181; ARC-36100) Avail: NTIS HC A04/MF A01; HMSO £2.20; PHI $8.53

Brief consideration of current approaches to the prediction of unsteady wing loading in mixed subsonic and supersonic flow shows a wide variety of method and a clear need for economy in transonic aerodynamic calculations for flutter clearance in subsonic flight. In support of measurements of steady and oscillatory pressure distributions on a particular wing, an approximate theoretical treatment was devised in terms of nonlinear steady surface pressures and linear oscillatory loading. The steady data were taken either from transonic small-perturbation theory or from the static experiments. The resulting theoretical or semi-empirical calculations can take account of stream Mach number, mean incidence, mode of oscillation, frequency, and amplitude. Like the dynamic experiments, the theoretical and semi-empirical results show large differences between oscillatory chordwise load distributions under subcritical and supercritical conditions, especially in the recompression region where the large and rapidly changing amplitude and phase of the measured loading are reproduced qualitatively in the calculations. The method should provide an economical indication of the importance of nonlinear flutter aerodynamics in the lower transonic regime. Author (ESA)

DATA SUMMARY: Combined theoretical and experimental study of aeroelastic flutter in supercritical wing design; the variables include planform, Mach number, frequency parameter, oscillation mode, airfoil section, camber and twist, incidence, oscillatory amplitude, and Reynolds number. 18 figures and 7 tables.

**N77-19018#** Royal Aircraft Establishment, Farnborough (England).

**THE MEASUREMENT OF AERODYNAMIC FORCES ON AN OSCILLATING MODEL OF A FAN-ENGINE NACELLE**

R. Cansdale and D. R. Gaukroger 30 Jun. 1976 29 p refs (RAE-TM-Struct-889; BR53602) Avail: NTIS HC A03/MF A01

A technique developed to measure the aerodynamic forces generated when a model fan-engine nacelle is oscillated in a uniform airflow enables the model to be oscillated in pitch or in yaw about one of two axis positions. A series of measurements for the four combinations of axis position and direction can be analyzed to yield the aerodynamic stiffness and damping derivatives for motions of pitch, yaw, and vertical and lateral translation. A preliminary series of tests was made using a simple model of a fan-engine in a low speed wind tunnel. The rig and test technique are described and the outcome of the tests discussed. Author (ESA)

DATA SUMMARY: No numeric data are presented.

**N77-19019#** Centre National d'Etudes Spatiales, Toulouse (France).

**STATISTICAL AND DYNAMIC STUDY OF CAPTIVE BALLOONS [ETUDE STATIQUE ET DYNAMIQUE DE BALLONS CAPTIFS]**

Michel Fauveau and Claude Quere Nov. 1976 73 p In FRENCH; ENGLISH summary

(CNES-NT-57) Avail: NTIS HC A04/MF A01

Two studies on tethered balloons at high altitude are described. The static equilibrium of tethered balloons as a function of the wind is dealt with: equilibrium altitude, length and shape of the cable. An extension is made to tethered balloons with auxiliary payloads and balloons distributed along the cable. Dynamics of tethered balloons are treated: ascension of the balloon with the cable either unwinding from a fixed landwinch or from a winch launched by the balloon itself. Author (ESA)

DATA SUMMARY: No numeric data are presented.

**N77-19020#** Centre National d'Etudes Spatiales, Toulouse (France).

**MATHEMATICAL STUDY OF TWO-BALLOON SYSTEM FLIGHT [ETUDE MATHEMATIQUE DU VOL D'UN SYSTEME DE DEUX BALLONS]**

Jean-Claude Kosik and Robert Regipa Nov. 1976 42 p refs In FRENCH; ENGLISH summary

(CNES-NT-58) Avail: NTIS HC A03/MF A01

A system of two balloons, one of which is open, was developed. Using the hypothesis of equal internal and external pressures, two equations of ascending motion are derived, one for the fast ascent, the other for the slow ascent in which there is gas outflow from the smaller balloon. The equations can be used either to plan flights or to process experimental flight data. Author (ESA)

DATA SUMMARY: No numeric data are presented.

**N77-19021#** Purdue Univ., Lafayette, Ind. Project Squid Headquarters.

**AN EXPERIMENTAL STUDY ON THE AERODYNAMIC RESPONSE OF A SUBSONIC CASCADE OSCILLATING NEAR STALL Technical Report, Sep. 1975 - Jul. 1976**

Franklin O. Carta and Arthur O. StHilaire Jul. 1976 114 p refs Prepared in cooperation with United Technologies Research Center, East Hartford, Conn.

(Contract N00014-75-C-1143; NR Proj. 098-038)

(AD-A029672; SQUID-TR-UTRC-2-PU; UTRC/R76-912270) Avail: NTIS HC A06/MF A01 CSCL 20/4

Tests were performed on a linear cascade of airfoils oscillating in pitch about their midchords at frequencies up to 17 cps, at velocities up to 200 ft/sec and at interblade phase angles of 0 and 45 deg, under conditions of high aerodynamic loading. The measured data included unsteady time histories from chordwise pressure transducers and chordwise hot films. Unsteady normal force coefficient, moment coefficient, and aerodynamic work per cycle of oscillation were obtained from integrals of the pressure data, and indications of the nature and extent of the separation phenomenon were obtained from an analysis of the hot film response data. The most significant finding of this investigation is that a change in interblade phase angle from 0 deg to 45 deg radically alters the character of the blade loading (which governs its motion in a free system) from stable to unstable. Furthermore, the stability or instability is governed primarily by the phase angle of the pressure distribution over the forward 10 to 15 percent of the blade chord. Reduced frequency and mean incidence angle changes were found to have a relatively minor effect on stability for the range of parameters tested. Author

DATA SUMMARY: Diverse data are presented; variables include pressure coefficient, time, incidence angle, harmonic pressure amplitude, harmonic phase angle, pitching moment coefficient, frequency, pitching moment phase angle, velocity, angle of attack.

**N77-19022#** Naval Surface Weapons Center, White Oak, Md.

**EXPERIMENTAL INVESTIGATION OF A FIN-CONE INTERFERENCE FLOW FIELD AT MACH 5**

Joseph D. Gillerlain, Jr. 8 Apr. 1976 80 p refs Presented at 10th Navy Symp. on Aeroballistics, Fredericksburg, Va., 15-17 Jul. 1975

(WF32322205)

(AD-A029999; NSWC/WOL/TR-75-63) Avail: NTIS HC A05/MF A01 CSCL 20/4

The general purpose of this investigation was to study the separated flow field associated with a fin-body juncture. Specific objectives included: (1) determining the severity and extent of aerodynamic heating, (2) providing flow visualization results to illustrate the flow structure, and (3) obtaining a data base of heat-transfer and surface-pressure measurements upon which to develop future analytical relations to predict peak interference heating levels. Tests were conducted at Mach 5 over a unit Reynolds number range of 4.5 to 26 million per foot. A fin-cone model was used. The data consist of surface-pressure distributions, heat-transfer measurements using the phase-change paint technique, and schlieren and oil-flow photographs. Results are presented for several fin-cone geometries to include fin sweep and fin-cone gap. Where possible, comparisons are made with fin-flat-plate data. Author (GRA)

DATA SUMMARY: Isoheating contours and surface pressure distribution on cones and leading edges of unswept and swept fins; variables include pressure distribution, heat transfer, Mach number, and Reynolds number; 9 figures include numeric data.

**N77-19023#** Edgewood Arsenal, Aberdeen Proving Ground, Md.
**A TECHNIQUE TO MEASURE THE PRESSURE DISTRIBUTION ACTING ON THE SURFACE OF A SPINNING BODY IN A WIND TUNNEL Technical Report, Dec. 1974 - Oct. 1975**
Miles C. Miller Sep. 1976 71 p
(DA Proj. 1T6-62618-AH-80)
(AD-A030430; ED-TR-76070) Avail: NTIS HC A04/MF A01 CSCL 20/4

This report describes a new experimental technique evolved to measure the pressure distribution on the surface of a spinning body in a wind tunnel. The technique was successfully demonstrated by a series of wind tunnel tests of a spinning cylinder in crossflow. Surface pressure surveys were obtained on the cylindrical model for various tip speed ratios at subcritical, critical, and supercritical Reynolds numbers. The validity of the data was established by comparing the integrated pressure values with directly measured force data. The resulting pressure distribution data allow interpretation of the fundamental Magnus phenomenon and clearly indicate boundary layer and flow separation effects. This testing technique is applicable to various model configurations, angles of attack, and Mach number regimes.Author (GRA)

DATA SUMMARY: Diverse data are presented; the variables include Reynolds number, pressure distribution, laminar boundary layer flow, turbulent boundary layer flow, test section velocity, aerodynamic configuration, lift drag ratio, tip speed, free stream velocity, aerodynamic force, and flow separation.

**N77-19024#** ARO, Inc., Arnold Air Force Station, Tenn.
**ANALYTICAL MODEL OF SUPERSONIC, TURBULENT, NEAR-WAKE FLOWS Final Report, Jul. 1973 - Dec. 1975**
C. E. Peters and W. J. Phares AEDC Sep. 1976 76 p refs
(AD-A030015; ARO-ETF-TR-76-69; AEDC-TR-76-127) Avail: NTIS HC A05/MF A01 CSCL 20/4

An analytical model for planar and axisymmetric, supersonic, turbulent, near-wake flows is presented. The viscous region behind the blunt base is described by the integral form of the boundary-layer equations, and the inviscid outer-flow region, including the remnant of the initial turbulent boundary layer, is computed with the rotational method of characteristics. The solution of the two regions is fully coupled. The saddle-point singularity, similar to the Crocco-Lees critical point, occurs downstream of the rear stagnation point. The base pressure is obtained by iteration of the initial conditions until the flow-field solution will pass through the singularity. Base bleed of a gas different from the outer-stream gas is included in the formulation, and provision is made to treat equilibrium chemical reactions in the viscous wake. However, an unresolved problem has been encountered in the solution of the species conservation equations. Therefore, results for only single gas flows are presented. The analytical model is shown to adequately predict the effect of free-stream Mach number and initial boundary layer on the planar base pressure. In addition, the planar flow-field structure is well predicted. Axisymmetric base pressure and flow-field structure are reasonably well predicted for free-stream Mach numbers greater than 2.0, but the turbulent transport model used yields only fair results for Mach numbers less than 1.7. The effect of base bleed on the axisymmetric base pressure is well predicted. Author (GRA)

DATA SUMMARY: Supersonic near wake flow field model; the variables include planar wake flow, axisymmetric flow, boundary layer flow, base pressure ratio, Mach number, flow reattachment, adiabatic flow, shear stream velocity, turbulent Reynolds number distribution, pressure gradients, and free stream; 31 figures and no tables.

**N77-19025#** ARO, Inc., Arnold Air Force Station, Tenn.
**A COMPUTER STUDY OF HYPERSONIC LAMINAR BOUNDARY-LAYER/SHOCK-WAVE INTERACTION USING THE TIME-DEPENDENT COMPRESSIBLE NAVIER-STOKES EQUATIONS Final Report, Jul. 1974 - Apr. 1976**
B. K. Hodge AEDC Sep. 1976 48 p refs
(AD-A029544; ARO-VKF-TR-76-64; AEDC-TR-76-119) Avail: NTIS HC A03/MF A01 CSCL 20/4

This report presents the results of an investigation of hypersonic laminar boundary-layer/shock-wave interactions using the method of MacCormack to solve the time-dependent compressible Navier-Stokes equations. Comparisons of the numerical solutions with experimental data were made to ascertain the validity of the numerical method and to identify regions of anomalous behavior. The algorithm gave good results when applied to hypersonic laminar interactions that caused either small or no separated regions and marginal performance when applied to hypersonic laminar interactions having large regions of separated flow. The extents of the separated regions in interactions having large regions of separated flow were underpredicted when compared with experimental data. The predicted wall heat-transfer rates exhibited the correct qualitative trend but not the experimentally measured quantitative values. Consideration of the effects of needed stabilizing terms as well as grid resolution suggests inadequate mesh spacing in the longitudinal direction as the cause of the aforementioned anomalies. If inadequate mesh spacing (and the corresponding lack of support for every term of the Navier-Stokes equations) is a prime cause of the cited discrepancies between the numerical results and the experimental data, then the needed reduction of several orders of magnitude in delta x would increase CPU time and core storage requirements to untenable levels.Author (GRA)

DATA SUMMARY: Numerical solution to Navier-Stokes equation in hypersonic regime; the variables include heat transfer, flow velocity, separation point, reattachment point, pressure ratio, shock wave incidence angle, inviscid flow, wave reflection, streamlines, leading edge shock shape, and Mach number; 14 figures and 1 table.

**N77-19026#** General Electric Co., Philadelphia, Pa. Missile and Space Div.
**RE-ENTRY VEHICLE FLIGHT TEST PRESSURE MEASUREMENTS (STEADY STATE AND FLUCTUATING): AN OVERVIEW Progress Report**
J. M. Cassanto and C. R. Droms 15 Feb. 1977 55 p refs
To be presented at the 23d ISA Intern. Instrument Symp., Las Vegas, Nev., 1-5 May 1977
(Doc-77SDR009) Avail: GE Space and RESD Libraries, P.O. Box 8555, Philadelphia, Pa. 19101; HC $10.00/MF $10.00

A chronological history is invented on how early generation R/V. flight pressure measurements (both steady state and fluctuating pressures) were made (with separate, large, bulky instruments at separate pressure port locations) to the present state of-the-art technology (solid-state, miniaturized, integrated sensors) having the capability to measure both steady state and fluctuating (acoustic) pressures simultaneously at the same port with the same sensor. These measurement techniques provide the flight test engineer with a unique tool to determine the forebody pressure distribution, forebody drag component of total drag, boundary layer transition onset, turbulent flow and the aeroacoustic environment. Typical flight test results are presented from the early generation pressure instrumentation to the current generation instrumentation. Finally the present day state-of-the-art of pressure measurements is defined for flight re-entry vehicles. Author

DATA SUMMARY: Survey on pressure transducers and measurement techniques with emphasis on miniaturized integrated solid state devices; the variables include fluctuating pressure, steady state pressure, frequency range, time response, transition flow, flow distribution, calibrating, pressure distribution, aerodynamic drag, angle of attack, Reynolds number, Stanton number, oscillating shock pressure, and heat transfer; 33 figures and no tables.

## 03 AIR TRANSPORTATION AND SAFETY

Includes passenger and cargo air transport operations; and aircraft accidents.

For related information see also *16 Space Transportation* and *85 Urban Technology and Transportation*.

**N77-19027#** Logistics Management Inst., Washington, D.C.
**THE NATIONAL STRATEGIC AIRLIFT DILEMMA,**

**VOLUME 1**
Howell M. Estes, Jr. Apr. 1976 32 p
(Contract SD-321)
(AD-A031015) Avail: NTIS HC A03/MF A01 CSCL 15/5

Volume I of this report attempts to put the strategic airlift problem in perspective. The intent is to provide a basis for better understanding the complex factors that influence the program. This volume concludes that although national war contingency plans currently depend heavily on strategic airlift, the existing combined capability of the Military Airlift Command (MAC) and the Civil Reserve Air Fleet (CRAF) is inadequate to meet the strategic airlift demands of those plans and that the readiness of MAC to respond to a war emergency is being jeopardized. Each of several interrelated factors which underlie these strategic airlift deficiencies is examined. GRA

**N77-19028#** Logistics Management Inst., Washington, D.C.
**THE NATIONAL STRATEGIC AIRLIFT DILEMMA: AN APPROACH TO SOLUTION, VOLUME 2**
Howell M. Estes, Jr. Apr. 1976 54 p
(Contract SD-321)
(AD-A031016) Avail: NTIS HC A04/MF A01 CSCL 15/5

This volume examines approaches toward solution, or at least amelioration, of the problems cited in Volume I. Complete resolution of the strategic airlift dilemma, even with continuing full support of necessary actions by all decision makers involved, cannot be expected realistically except in the long term. There are, however, actions which can be implemented immediately, which would, in the near or mid-term timeframe, narrow the gap between strategic airlift capability and known wartime airlift requirements and improve MAC readiness posture. Recommendations are included for correcting many of the perceived deficiencies. GRA

**N77-19029#** Army Command and General Staff Coll., Fort Leavenworth, Kansas.
**UTILITY TACTICAL TRANSPORT AIRCRAFT SYSTEM (UTTAS). A CRITICAL LOOK AT ITS REPAIRABILITY M.S. Thesis. Final Report**
Jerry R. Varnon 11 Jun. 1976 91 p refs
(AD-A029992) Avail: NTIS HC A05/MF A01 CSCL 01/3

Procurement of the UTTAS as designed in prototype models will require changes in the existing aircraft maintenance system to insure repairability at DS level. The UTTAS structural design was studied to assess the army's capability to repair the UTTAS if or when damaged in combat. Analogies are drawn between the complexity of the UTTAS and the Chinook and Skycrane. Historical examples of research and development efforts are used to point out the shortcomings experienced with the 'new technology' associated with helicopters deployed in Vietnam. Criticism of many of those aircraft is correlated directly with the UTTAS to point out that new technology is not necessarily good technology with respect to repairability. The author contends that the new three level aircraft maintenance system that evolved from Vietnam experience is outmoded and incapable of supporting the UTTAS in the short, violent, lethal war scenario in Europe. Recommendations include: a change in management of CMF 67 personnel to provide a large pool of skilled MOS 68 series repairmen; revision of the three level system to provide theater capability for extensive GS airframe repair; revision of TM's to provide standards of serviceability for peacetime and lesser standards for wartime; pursuing new technology in airframe repair; and retention/procurement of a simpler refined technology aircraft. Author (GRA)

**N77-19030#** LTV Aerospace Corp., Dallas, Tex. Vought Systems Div.
**SAFE EJECTION ENVELOPE DISPLAY SYSTEM DEVELOPMENT PROGRAM. PHASE 4A: PRELIMINARY FLIGHT TEST Final Report**
T. L. Harper and T. A. Pfaff Sep. 1976 197 p refs
(Contract N62269-76-C-0017)
(AD-A030642; LTV-2-57110/6R-3300; NADC-76262-40)
Avail: NTIS HC A09/MF A01 CSCL 01/3

The SENDS system is designed to provide the aircrewman with a continuous indication of inflight escape capability. The concept as conceived by Vought, monitors the aircraft dynamic correlation by means of onboard sensors, provides these data to an onboard computer which computes escape capability and displays the current status in terms of time remaining to initiate an ejection and still be within the safe recovery envelope of the escape system. Preliminary flight testing has indicated that the SENDS concept is feasible for incorporation into ejection seat equipped aircraft. Evaluation of the flight test data indicates that the SENDS system performed as designed throughout the conventional flight envelope including maneuvers such as taxi, takeoff, climbout, cruise, descent, approach and landing. Data are presented for a total of 34 aircraft maneuvers. Additional software refinements are recommended to optimize the system performance during spins. It is recommended that Phase IV B and C System Design and Refinement and Phase V System Flight test be conducted. GRA

**N77-19031#** Advisory Group for Aerospace Research and Development, Paris (France).
**AIRCRAFT OPERATIONAL EXPERIENCE AND ITS IMPACT ON SAFETY AND SURVIVABILITY**
Jan. 1977 329 p Presented at the Flight Mech. Panel Symp., Sandefjord, Norway, 31 May - 3 Jun. 1976
(AGARD-CP-212) Avail: NTIS HC A15/MF A01

Aircraft safety and survivability are discussed for accident prevention and aircraft reliability. Safety management and accident investigations are described for improving pilot and aircraft performance. For individual titles, see N77-19032 through N77-19055.

**N77-19032#** Army Air Mobility Research and Development Lab., Fort Eustis, Va.
**U.S. ARMY HELICOPTER ACCIDENT EXPERIENCE**
George T. Singley, III and Laurel D. Sand (Army Agency for Aviation Safety, Ft. Rucker, Ala.) *In* AGARD Aircraft Operation Experience and its Impact on Safety and Survivability, Jan. 1977 6 p (For primary document see N77-19031 10-03)
Avail: NTIS HC A15/MF A01

U.S. Army helicopter accident experience for the period FY68 through FY75 is examined. Helicopter operational trends such as the declining accident rate, fatality rate, and hours flown are discussed. Helicopter accident causes, conditions, and casualties are discussed. Data for crashes resulting from enemy combat actions are not included. A summary of recent advances in helicopter crashworthiness which promise to reduce future material and human losses due to helicopter accidents is included. Author

**N77-19033#** Air Force Inspection and Safety Center, Norton AFB, Calif.
**USAF ACCIDENT PREVENTION PROGRAM**
Alfred C. Baker, Jr. *In* AGARD Aircraft Operation Experience and its Impact on Safety and Survivability, Jan. 1977 5 p (For primary document see N77-19031 10-03)
Avail: NTIS HC A15/MF A01

A number of the systematic approaches which are aimed at isolating and quantifying hazards during the conceptual stage are discussed. It is anticipated that they will contribute substantially to a still further reduction in the rate of accidents experienced. Author

**N77-19034#** National Research Council of Canada, Ottawa (Ontario).
**THE RECOVERY AND ANALYSIS OF ACCIDENT DATA FROM FLIGHT RECORDERS IN CANADIAN TRANSPORT AIRCRAFT**
B. Caiger *In* AGARD Aircraft Operation Experience and its Impact on Safety and Survivability, Jan. 1977 23 p refs (For primary document see N77-19031 10-03)
Avail: NTIS HC A15/MF A01

A Playback Center was established that is acquiring unique experience in recovering and analyzing information from a wide range of aircraft audio and data recorders. In particular, the Center was designed to handle all cockpit voice recorders and flight data recorders fitted to Canadian civil and military transport aircraft. Recorders are forwarded to the Center whenever incidents or accidents warrant investigation by the authorities concerned. The playback facilities were designed with special emphasis on the problems that might be encountered in these cases. Routine monitoring is also conducted on the military systems for

maintenance purposes. Current and future capabilities of the Center are summarized, and examples are given of some of the work that was undertaken. Author

**N77-19035#** Department of Trade and Industry, London (England).
**THE FLIGHT RECORDER AND ACCIDENT INVESTIGATION**
Geoffrey C. Wilkinson *In* AGARD Aircraft Operation Experience and its Impact on Safety and Survivability, Jan. 1977 20 p (For primary document see N77-19031 10-03)
Avail: NTIS HC A15/MF A01

An attempt to give perspective to the introduction of the flight data recorders (FDR) in civil aviation is presented. The dangers inherent in a proliferation of different FDR equipment should be fully appreciated. Civil aviation learned from bitter experience the cost of noncompatible FDR equipment. A detailed analysis of a FDR record from an actual accident is presented, demonstrating some of the techniques used in FDR data analysis. Author

**N77-19036#** Royal Netherlands Air Force, The Hague.
**AN ACCIDENT ANALYSIS OF FIGHTER AIRCRAFT IN RELATION TO MODIFICATIONS INTRODUCED AND NEW DEVELOPMENTS**
A. P. Okkelman *In* AGARD Aircraft Operation Experience and its Impact on Safety and Survivability, Jan. 1977 4 p (For primary document see N77-19031 10-03)
Avail: NTIS HC A15/MF A01

Fighter aircraft accidents are discussed for aircraft survivability from takeoff to landing. The analysis of some typical accidents is presented for accident prevention. M.C.F.

**N77-19037#** National Transportation Safety Board, Washington, D.C. Bureau of Aviation Safety.
**CIVIL AIRCRAFT ACCIDENT ANALYSIS IN THE UNITED STATES-THE JET AGE**
Coe M. Anderson *In* AGARD Aircraft Operation Experience and its Impact on Safety and Survivability, Jan. 1977 6 p (For primary document see N77-19031 10-03)
Avail: NTIS HC A15/MF A01

The investigations and investigative techniques are presented for the total fatal U.S. air carrier turbojet accident experience from 1958 through 1975. Early series of 707 and DC-8 accidents are examined and analyzed along with certain recent wind shear accidents. Author

**N77-19038#** Societe Nationale Industrielle Aerospatiale, Blagnac (France).
**FORECAST ASSESSMENT OF THE TOTAL LEVEL OF SAFETY FOR A CIVIL AVIATION TRANSPORT AIRCRAFT [EVALUATION PREVISIONNELLE DU NIVEAU GLOBAL DE SECURITE D'UN AVION DE TRANSPORT CIVIL]**
C. Lenseigne *In* AGARD Aircraft Operation Experience and its Impact on Safety and Survivability, Jan. 1977 7 p In FRENCH (For primary document see N77-19031 10-03)
Avail: NTIS HC A15/MF A01

A method is described for assuring total safety for aircraft with large integrated systems. Because certain elementary failures of equipment have the same consequences as failure of other equipment in the same system, it is possible to group them into a failure resume for the system. The group remains unchanged in all systems studies and is considered an independent factor in all probabilities. All failure resumes are combined for total safety evaluation. Trans. by A.R.H.

**N77-19039#** Avions Marcel Dassault-Breguet Aviation, Saint-Cloud (France).
**SAFETY ANALYSIS OF THE FLIGHT CONTROL OF MERCURE AIRCRAFT [ANALYSE DE SECURITE DES COMMANDES DE VOL DU MERCURE]**
J. F. Georges *In* AGARD Aircraft Operation Experience and its Impact on Safety and Survivability, Jan. 1977 5 p In FRENCH (For primary document see N77-19031 10-03)
Avail: NTIS HC A15/MF A01

Certification of the Mercure was conducted in collaboration with French Official Services, using a method based on characterization of all systems' components and the analysis of all imaginable simple and multiple failures. Trans. by A.R.H.

**N77-19040#** Hawker Siddeley Aviation Ltd., Kingston upon Thames (England).
**FAILURE MODE ANALYSIS IN THE LIGHT OF EXPERIENCE**
H. A. G. Waugh and M. R. Dawn *In* AGARD Aircraft Operation Experience and its Impact on Safety and Survivability, Jan. 1977 13 p (For primary document see N77-19031 10-03)
Avail: NTIS HC A15/MF A01

Aircraft equipment failure and the cost of maintenance are discussed for accident prevention. Aircraft reliability and mission effectiveness are described for aircraft survivability. M.C.F.

**N77-19041*#** National Aeronautics and Space Administration, Washington, D.C. Aviation Safety Technology Branch.
**AVIATION SAFETY AND OPERATION PROBLEMS RESEARCH AND TECHNOLOGY**
John H. Enders and Joseph W. Strickle (NASA Langley Research Center) *In* AGARD Aircraft Operation Experience and its Impact on Safety and Survivability, Jan. 1977 30 p refs (For primary document see N77-19031 10-03)
Avail: NTIS HC A15/MF A01 CSCL 01C

Aircraft operating problems are described for aviation safety. It is shown that as aircraft technology improves, the knowledge and understanding of operating problems must also improve for economics, reliability and safety. M.C.F.

**N77-19042#** Boeing Commercial Airplane Co., Seattle, Wash. Flight Deck Development Group.
**FLIGHT DECK TECHNIQUES: A NEW APPROACH TO SAFETY**
Hartwell G. Stoll *In* AGARD Aircraft Operation Experience and its Impact on Safety and Survivability, Jan. 1977 11 p (For primary document see N77-19031 10-03)
Avail: NTIS HC A15/MF A01

The present commercial aircraft operational experience shows that the percent of accidents that is crew related has remained almost constant over the last few years. Since the future airline operational environment is expected to increase in complexity, some new types of techniques for flight deck design will be required if a significant reduction in crew caused accident rate is to be achieved. There are several new techniques and technological advances in flight deck designs that can contribute to improvement of commercial aircraft operational safety. The digital computer technology alone allows a degree of flexibility in both design techniques and controls and displays that was not possible a few years ago. Improved engine control energy management, systems, improved caution and warning systems, windshields designed for better collision avoidance capability, and overall simplification of the flight deck are some of the improvements that this new technology can provide. Author

**N77-19043#** Dornier-Werke G.m.b.H., Friedrichshafen (West Germany).
**STUDY (SAFETY ANALYSIS) OF AIRCRAFT SYSTEMS DURING TAKE-OFF AND LANDING**
R. Keppeler *In* AGARD Aircraft Operation Experience and its Impact on Safety and Survivability, Jan. 1977 19 p refs (For primary document see N77-19031 10-03)
Avail: NTIS HC A15/MF A01

A general survey of accident statistics and the results of the evaluation of accident reports which were carried out to define, in a quantitative way, the causes of accidents and critical flight phases are presented. The results show that, besides the technical safety, human behavior in interaction with technology is of special importance. This should be taken into account to a greater extent with regard to future developments. A possible method for a treatment on a systems analysis basis is demonstrated by means of typical examples. In this context, procedures (e.g. for approach and departure) and activity analyses for a selected aircraft type are presented, on the basis of which a digital simulation for the approach procedure, for example, can be established, as shown. As a result, unsatisfactory design, especially for the cockpit, may be identified, and recommendations for training and decision aids for the operation can be derived. Author

**N77-19044*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
**THE INFLUENCE OF HANDLING QUALITIES ON SAFETY AND SURVIVABILITY**
Seth B. Anderson *In* AGARD Aircraft Operation Experience and its Impact on Safety and Survivability, Jan. 1977 10 p refs (For primary document see N77-19031 10-03)
Avail: NTIS HC A15/MF A01 CSCL 01C

The relationship of handling qualities to safety and survivability of military aircraft is examined which includes the following: (1) a brief discussion of the philosophy used in the military specifications for treatment of degraded handling qualities, (2) an examination of several example handling qualities problem areas which influence safety and survivability; and (3) a movie illustrating the potential dangers of inadequate handling qualities features. Author

**N77-19045#** Army Air Mobility Research and Development Lab., Fort Eustis, Va.
**DESIGN OF HELICOPTERS FOR SURVIVABILITY**
George T. McAllister *In* AGARD Aircraft Operation Experience and its Impact on Safety and Survivability, Jan. 1977 22 p refs (For primary document see N77-19031 10-03)
Avail: NTIS HC A15/MF A01

A review of the design features, criteria, and experience that the U.S. Army has had with designing helicopters for survivability is presented. Specific areas covered are infrared radiation, radar cross section, aural detectability, ballistic damage tolerance, and crashworthiness. A few of the more interesting areas of work are highlighted, as well as improvements in aircraft survivability planned for the future. Author

**N77-19046#** Vereinigte Flugtechnische Werke-Fokker G.m.b.H., Bremen (West Germany).
**DESIGNING THE SURVIVABILITY OF FLYING WEAPON SYSTEM**
H. Schmidtlein, K. Belsonherz, and M. Mohring *In* AGARD Aircraft Operation Experience and its Impact on Safety and Survivability, Jan. 1977 11 p (For primary document see N77-19031 10-03)
Avail: NTIS HC A15/MF A01

Based on investigations of remotely piloted vehicles systems, the importance of survivability and the possible threat of enemy ground-to-air defense systems to RPV's are illustrated. Five principles to increase the survivability of RPV weapon systems are described which can be evaluated mainly with respect to cost effectiveness and mission effectiveness. Test and simulation results for the various principles are discussed. Author

**N77-19047#** Institut de Mecanique des Fluides de Lille (France).
**BEHAVIORAL PREDICTION OF WATER AND EMERGENCY LANDINGS [PREVISION DU COMPORTEMENT A L'AMERRISSAGE ET A L'ATTERRISSAGE FORCE]**
Francis Dupriez *In* AGARD Aircraft Operation Experience and its Impact on Safety and Survivability, Jan. 1977 6 p refs In FRENCH; ENGLISH summary (For primary document see N77-19031 10-03)
Avail: NTIS HC A15/MF A01

Catapulted free-flight models of aircraft used at the design phase of a project as a prediction tool of the crash and ditching behavior of the full-scale aircraft are investigated. Similarity laws used for the dynamics of the airframe and the structural representation are given. A typical ditching test model is described. A review of current ditching test procedures is given. Recent improvements of the methods allowing a better simulation of the full-scale phenomena and a better analysis of the local structural behavior are presented and compared to global behavior methods used in the past years. Aircraft ditching test results are presented with emphasis on the influence of the main parameters. Application to helicopter testing is briefly mentioned. The description of a newly-operated multipurpose facility based on the catapult technique which can also be used for cross-wind landing studies is also included. Author

**N77-19048#** McDonnell-Douglas Corp., Long Beach, Calif.
**REDUCING FIRE HAZARDS IN COMMERCIAL TRANSPORT AIRCRAFT**
Roger D. Schaufele *In* AGARD Aircraft Operation Experience and its Impact on Safety and Survivability, Jan. 1977 16 p refs (For primary document see N77-19031 10-03)
Avail: NTIS HC A15/MF A01

The status of fire prevention design practices for current commercial transport aircraft is surveyed, and research and development activities aimed at providing additional fire prevention design criteria are reviewed. To enable treatment of such a broad subject in a somewhat orderly manner, this paper is arranged to cover the development of fire preventing design concepts, a review of actual fire incidents, and an overview of related research and development activities. Author

**N77-19049#** Federal Aviation Administration, Washington, D.C.
**THE FEDERAL AVIATION ADMINISTRATION AND AVIATION SAFETY**
David J. Sheftel *In* AGARD Aircraft Operation Experience and its Impact on Safety and Survivability, Jan. 1977 8 p (For primary document see N77-19031 10-03)
Avail: NTIS HC A15/MF A01

The Federal Aviation Administration's safety systems are analyzed together with the programs and projects to achieve an ultimate goal of zero accidents. I.M.

**N77-19050#** Naval Air Systems Command, Washington, D. C.
**DESIGN FOR REDUCTION OF AIRCRAFT VULNERABILITY**
R. T. Remers *In* AGARD Aircraft Operation Experience and its Impact on Safety and Survivability, Jan. 1977 23 p (For primary document see N77-19031 10-03)
Avail: NTIS HC A15/MF A01

A discussion of aircraft survivability in a nonnuclear threat environment and, in particular, that part of the total survivability discipline that encompasses the application of engineering design concepts and techniques to reduce the vulnerability of aircraft components and systems to the physical damage effects of projectiles and fragmenting warheads is presented. A brief overview of the aircraft survivability discipline to better define the roll of vulnerability reduction in the solution of the total aircraft survivability enhancement problem is given. The report then goes on to describe: (1) the results of analyses of fixed-wing aircraft combat losses in the Southeast Asia conflict, (2) the identification of the suspected aircraft system damage and failure modes that resulted in the loss of aircraft, (3) the verification by ballistic testing of many of these failure modes, (4) the vulnerability reduction features that have been developed and tested to protect aircraft systems, (5) design guidance that has been developed to aid in mission oriented aircraft configuration and systems location, and (6) examples of application of this design guidance to new aircraft. Author

**N77-19051#** Civil Aviation Authority, Redhill (England).
**THE CAA MANDATORY OCCURRENCE REPORTING SYSTEM**
Peter Meiklem *In* AGARD Aircraft Operation Experience and its Impact on Safety and Survivability, Jan. 1977 18 p (For primary document see N77-19031 10-03)
Avail: NTIS HC A15/MF A01

This committee had been instructed by the government of the day to examine the economic and regulatory conditions in the UK air transport industry, and had recommended a merger of the bodies then separately responsible for the control of route licences, operational and airworthiness regulation, and air traffic control services. Mandatory incident and defect reporting was introduced. Author

**N77-19052#** Service Technique de l'Aeronautique, Paris (France).
**PILOTING A PATH IN 1976 [PILOTAGE DE LA TRAJECTOIRE EN 1976]**
Gilbert Klopfstein *In* AGARD Aircraft Operation Experience and its Impact on Safety and Survivability, Jan. 1977 3 p In FRENCH (For primary document see N77-19031 10-03)
Avail: NTIS HC A15/MF A01

Aircraft accidents during landing approaches are due to errors in judgment which are tied to the poor quality of information given, and not to the performance of the pilot. The condemnation of manual control during this phase of flight was hasty. With adequate information, based on six parameters abstracted from

routine experience, the simplification of piloting systems can be achieved. Trans. by A.H.

**N77-19053#** Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio. Biodynamics Div.

**PHYSIOLOGICAL AND PSYCHOLOGICAL FACTORS IN AIRCRAFT OPERATIONS: AN OVERVIEW**

Henning E. VonGierke *In* AGARD Aircraft Operation Experience and its Impact on Safety and Survivability, Jan. 1977 14 p refs (For primary document see N77-19031 10-03)

Avail: NTIS HC A15/MF A01

New technologies evolving in the form of more sophisticated physiological, behavioral and human operator man-in-the-loop models mark progress in these areas. However, laboratory data and models based on them are always open to criticism, since, in spite of efforts to stimulate the real situation, the lack of realism with respect to environment, task, motivation and equipment remains. This criticism is still more justified with respect to extrapolation to combat conditions. The collection and evaluation of operational experiences including combat data collection have probably not progressed as much as laboratory research and simulation. Even if complexity and cost of field studies explain this state of affairs, it is nonetheless important to realize this deficiency. A final contribution to the analysis of pilot/aircrew, as well as systems performance, is provided by accident analysis and interpretation. Author

**N77-19054#** KLM Royal Dutch Airlines, Amsterdam (Netherlands). Head Flight Safety Dept.

**ALERT FOR SAFETY - AN AIRLINE APPROACH**

G. C. Wansbeek *In* AGARD Aircraft Operation Experience and its Impact on Safety and Survivability, Jan. 1977 5 p (For primary document see N77-19031 10-03)

Avail: NTIS HC A15/MF A01

Safetywise the ultimate goal of any airline is no accidents and no important incidents. When this ideal situation is achieved the operator must be on the alert to prevent any development of self-confidence, and he must take the necessary steps to achieve this. Although this activity certainly may not be limited to cockpit personnel it is evident that the position of these crew members in the total operational loop is such that they have a primary responsibility to operate safely. The way in which pilots and flight-engineers are approached, however, must be carefully planned, and the best approach will differ from airline to airline. The method KLN Royal Dutch Airlines has chosen is described. Author

**N77-19055#** Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany).

**RECENT RESEARCH IN COMBAT AIRCRAFT AND HELICOPTER RESCUE SYSTEMS**

U. Schmidt *In* AGARD Aircraft Operation Experience and its Impact on Safety and Survivability, Jan. 1977 16 p refs (For primary document see N77-19031 10-03)

Avail: NTIS HC A15/MF A01

Actual accidents of combat fighters as well as changes in their mission profiles have raised problems which require rescue systems improvements, some of which are discussed herein. Measuring methods and correlations between theory and test results are presented. Some observations that affect theoretical predictions during the ejection phases are discussed in detail. Furthermore, a survey is given of rescue concepts for helicopter crews. Two concepts, bailout during autorotation and, as a most likely system, the upward extraction after rotor blade separation, are discussed in depth. For the latter, emphasis is placed on basic research through use of wind tunnel and free flight models. Author

## 04 AIRCRAFT COMMUNICATIONS AND NAVIGATION

Includes digital and voice communication with aircraft; air navigation systems (satellite and ground based); and air traffic control.

For related information see also *17 Spacecraft Communications, Command, and Tracking* and *32 Communications*.

**N77-19056*** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

**MAGNETIC HEADING REFERENCE Patent**

Howell D. Garner, inventor (to NASA) Issued 8 Feb. 1977 12 p Filed 16 Oct. 1975 Supersedes N76-26180 (14-17, p 2152) Division of US Patent Appl. SN-531647, filed 11 Dec. 1974, US Patent-3,943,763

(NASA-Case-LAR-11387-2; US-Patent-4,006,631; US-Patent-Appl-SN-623156; US-Patent-Class-73-178R; US-Patent-Class-33-356; US-Patent-Appl-SN-531647; US-Patent-3,943,763) Avail: US Patent Office CSCL 17G

This invention employs a magnetometer as a magnetic heading reference for a vehicle such as a small aircraft. The magnetometer is mounted on a directional dial in the aircraft in the vicinity of the pilot such that it is free to turn with the dial about the yaw axis of the aircraft. The invention includes a circuit for generating a signal proportional to the northerly turning error produced in the magnetometer due to the vertical component of the earth's magnetic field. This generated signal is then subtracted from the output of the magnetometer to compensate for the northerly turning error. Official Gazette of the U.S. Patent Office

**N77-19057#** Applied Physics Lab., Johns Hopkins Univ., Laurel, Md.

**EXPERIMENTAL RESEARCH ON THE PROPAGATION OF LORAN-C SIGNALS. VOLUME B: TEST OPERATIONS**

T. A. McCarty, S. F. Oden, C. M. DeLoriea, R. R. Smith, and W. J. Klepczynski Aug. 1976 89 p refs

(Contract N00017-72-C-4401)

(AD-A029888; APL/JHU-TG-1298B) Avail: NTIS HC A05/MF A01 CSCL 20/14

This report describes the planning and execution of test operations for an experiment conducted by The Johns Hopkins University Applied Physics Laboratory for the U.S. Air Force and the Defense Advanced Research Projects Agency to determine the validity of one facet of the theory of groundwave propagation at 100 kHz. Volume A is the summary report, Volume C describes the measurement system, and Volume D documents the data and analysis. The goal of the experiment was to determine if an analytic function could be developed for operational use that relates secondary phase factor to envelope to cycle difference so that geodetic position can be computed, accurately and in real time, from Loran-C coordinates. Field test data were collected and analyzed. They show trends that tend to support the hypothesis that the desired functional relationship exists, at least under certain conditions. Additional analysis, and perhaps tests, will be necessary to define these conditions or to prove conclusively the existence of such a relationship. GRA

## 05 AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes aircraft simulation technology.

For related information see also *18 Spacecraft Design, Testing and Performance* and *39 Structural Mechanics*.

**N77-19058*#** Boeing Vertol Co., Philadelphia, Pa.

**RESEARCH REQUIREMENTS FOR THE REDUCTION OF HELICOPTER VIBRATION**

Glidden S. Doman Dec. 1976 37 p refs

(Contract NAS1-13624)

(NASA-CR-145116; D210-11154-1) Avail: NTIS HC A03/MF A01 CSCL 01C

All prospective approaches to the reduction of helicopter vibrations were searched to establish insight for the planning of a corrective research program. The state of the art as revealed in the literature is summed up and followed by a discussion of state-of-the-art solutions and of identified technological gaps. It is applicable to all helicopters without regard to size. Extending the historic trend toward lower vibration levels will require the successful application of principles which isolate the fuselage from the rotor systems. Simplicity of the necessary isolation systems should be facilitated by providing other refinements of the dynamic design of the system. Author

**N77-19059*#** Boeing Vertol Co., Philadelphia, Pa.
**RESEARCH REQUIREMENTS FOR EMERGENCY POWER TO PERMIT HOVER-ONE-ENGINE-INOPERATIVE HELICOPTER OPERATION**
James H. Yost Dec. 1976 47 p refs
(Contract NAS1-13624)
(NASA-CR-145115) Avail: NTIS HC A03/MF A01 CSCL 01C

The research and technology demonstration requirements to achieve emergency-power capability for a civil helicopter are documented. The goal for emergency power is the ability to hover with one engine inoperative, transition to minimum-power forward flight, and continue to a safe landing where emergency power may or may not be required. The best method to obtain emergency power is to augment the basic engine power by increasing the engine's speed and turbine-inlet temperature, combined with water-alcohol injection at the engine inlet. Other methods, including turbine boost power and flywheel energy, offer potential for obtaining emergency power for minimum time durations. Costs and schedules are estimated for a research and development program to bring emergency power through a hardware-demonstration test. Interaction of engine emergency-power capability with other helicopter systems is examined. Author

**N77-19060*#** Boeing Commercial Airplane Co., Seattle, Wash.
**AEMS IMPLEMENTATION COST STUDY FOR BOEING 727 Final Report**
Robert L. Allison Feb. 1977 89 p refs
(Contract NAS2-8953)
(NASA-CR-151942; D6-44339) Avail: NTIS HC A05/MF A01 CSCL 01C

Costs for airline operational implementation of a NASA-developed approach energy management system (AEMS) concept, as applied to the 727 airplane, were determined. Estimated costs are provided for airplane retrofit and for installation of the required DME ground stations. Operational costs and fuel cost savings are presented in a cost-of-ownership study. The potential return on the equipment investment is evaluated using a net present value method. Scheduled 727 traffic and existing VASI, ILS, and collocated DME ground station facilities are summarized for domestic airports used by 727 operators. Author

**N77-19061*#** Boeing Commercial Airplane Co., Seattle, Wash.
**APPLICATION OF NASA-ARC DELAYED FLAP APPROACH PROCEDURES TO BOEING 727 AIRPLANE Final Report**
Robert L. Allison Feb. 1977 103 p refs
(Contract NAS2-8953)
(NASA-CR-137907; D6-44380) Avail: NTIS HC A06/MF A01 CSCL 01C

The results of an engineering and piloted simulator study to adapt a NASA developed-approach energy management system (AEMS) concept to the B727 are presented. The AEMS concept was developed and flight tested on a CV-990. The purpose of the AEMS is to reduce approach time, fuel, and noise by providing computer-driven cockpit displays to assist the pilot in flying optimized delayed flap approach (DFA) procedures. Development of the DFA flight profiles, the AEMS airborne digital computer algorithm, and associated cockpit displays were studied. Study ground rules and pertinent aerodynamic and noise trend data used in developing the flight profiles are presented. Approach time, fuel, and noise for the DFA are compared to several other types of procedures. Author

**N77-19062#** Lear Siegler, Inc., Wright-Patterson AFB, Ohio. Management Services Div.
**C-141 ALL WEATHER LANDING SYSTEM ENGINEERING SUPPORT Final Report, 7 Aug. 1972 - 31 Oct. 1975**
John S. Kozina Jun. 1976 152 p Sponsored in part FAA, Washington, D. C.
(Contract F33615-72-C-1358; AF Proj. 2187)
(AD-A029467; AFFDL-TR-76-46) Avail: NTIS HC A08/MF A01 CSCL 01/4

The systems and equipment described augment the capability of the standard C-141 Category II All Weather Landing System (AWLS) to operate in Category III weather conditions. This final report describes the physical location, operation, and theory of operation of the individual systems. A description of the on-board test instrumentation used to document the results of the AWLS test flights is included. A simulation model of the NC-141A test aircraft was developed to facilitate analysis of an AWLS operation on a system mock-up. The aircraft equations of motion which were used and the results of the simulation model testing are a part of this report. GRA

**N77-19063#** AiResearch Mfg. Co., Torrance, Calif.
**ELECTROMECHANICAL ACTUATION FEASIBILITY STUDY Final Report, Jan. - Dec. 1975**
Neal E. Wood, E. F. Echols, and John H. Ashmore May 1976 190 p refs
(Contract F33615-75-C-3055; AF Proj. 1987)
(AD-A031146; AFFDL-TR-76-42) Avail: NTIS HC A09/MF A01 CSCL 01/4

An alternate to hydraulic actuation of primary flight control surfaces is desirable. Electromechanical actuation of primary flight controls is feasible and practical using the most recent advances in the state-of-the-art in magnetic materials for high-performance servomotors, high-current-capacity transistor switches for motor power control, and digital microprocessors for servo and redundancy management logic. Electromechanical actuation is consistent with current, proven, fly-by-wire technology and with the developing power-by-wire techniques. The control surface performance requirements and methods of analysis are presented for direct drive electromechanical power servos. Trade studies were conducted to evaluate the aircraft power source and distribution options; actuator motor and controller options; and geared rotary hinge actuator configuration options. A weight comparison is given between the hydraulic actuation system for the F-100 and the electromechanical system studied. Reliability assessments and redundancy management considerations also are included. A preliminary design of the electromechanical actuation system and test plan is presented. These data were developed using a selected baseline problem statement which was derived from existing hydraulic actuator specifications. GRA

**N77-19064#** Kaman Aerospace Corp., Bloomfield, Conn.
**DEVELOPMENT PROGRAM FOR FIELD-REPAIRABLE/EXPENDABLE MAIN ROTOR BLADES Final Report**
J. E. Miller and T. N. Cook Sep. 1976 275 p refs
(Contract DAAJ02-73-C-0006; DA Proj. 1F1-63209-DB-38)
(AD-A030835; R-1387; USAAMRDL-TR-76-9) Avail: NTIS HC A12/MF A01 CSCL 01/3

This report details the work completed in designing and developing a main rotor blade for the UH-1D/H Helicopter which would reduce the Army's blade-related helicopter costs. This cost reduction results from designing a blade with high repairability to reduce damage-related repair and scrappage costs, high survivability so that required repairs are minimized and low production cost so that the blade could be economically discarded in case of severe damage. The program was unique in that reliability and maintainability personnel had inputs to the designs from their inception in the comparison of candidate designs and the selection of the final design concept. A maintenance philosophy was developed for the blade, and the repair techniques developed were proven to be easy to apply, and structurally sound during fatigue and whirl testing. Thus, the blade was shown to be repairable after extensive damage, and the repairs required less time than is normally required for blade removal and replacement. During the design of the blades, components were evaluated for their durability under the extremes of the Army's operating environment prior to their incorporation into the final design concept, and the design was analyzed and projected to be no less durable than the present UH-1D/H blade. The survivability, acquisition cost, repair cost, and replacement

costs were all used to predict the life-cycle costs of the new blade in comparison to that already in use. This comparison showed that a substantial cost saving could accrue to the Army as a result of employing this new design philosophy on helicopter blade acquisitions. Author (GRA)

**N77-19065#** Boeing Vertol Co., Philadelphia, Pa.
**ACTIVE ARM (EXTERNAL CARGO) STABILIZATION SYSTEM FLIGHT DEMONSTRATION Final Report, Jul. 1974 - Apr. 1976**
Theodore S. Garnett, Jr. and James H. Smith Sep. 1976 127 p refs
(Contract DAAJ02-74-C-0063; DA Proj. 1F2-63209-D-433)
(AD-A031062; D210-11078-1; USAAMRDL-TR-76-23) Avail: NTIS HC A07/MF A01 CSCL 01/3

Development of an advanced Active Arm External Load Stabilization System (AAELSS II) for helicopters has been accomplished through analysis, ground test, and flight evaluation of the concept on a CH-47C aircraft. Hydraulically powered arms mounted beneath the helicopter automatically control load motion to provide pendular damping levels in excess of 25% of critical. The system completely eliminates longitudinal pilot-induced oscillation (PIO) tendencies, permitting full envelope instrument meteorological conditions (IMC) flight with heavy external payloads. Potential for precision hover load placement and flight with unstable loads exists. The design is also capable of operating with winchable HLH cargo hoist cable systems. Author (GRA)

**N77-18995#** Royal Aircraft Establishment, Farnborough (England). Aerodynamic Dept.
**INTRODUCTORY COMMENTS ON AERODYNAMIC NOISE CONSIDERATIONS IN AIRCRAFT DESIGN AND OPERATION**
John Williams *In* AGARD Aerodynamic Noise, Jan. 1977 10 p (For primary document see N77-18994 10-01)
Avail: NTIS HC A14/MF A01

# 06 AIRCRAFT INSTRUMENTATION

Includes cockpit and cabin display devices; and flight instruments.

For related information see also *19 Spacecraft Instrumentation* and *35 Instrumentation and Photography*.

**N77-19066*#** Boeing Commercial Airplane Co., Seattle, Wash.
**THE 727 APPROACH ENERGY MANAGEMENT SYSTEM AVIONICS SPECIFICATION (PRELIMINARY)**
D. O. Jackson and A. A. Lambregts Aug. 1976 124 p
(Contract NAS2-8953)
(NASA-CR-137906; D6-44119) Avail: NTIS HC A06/MF A01 CSCL 01D

Hardware and software requirements for an Approach Energy Management System (AEMS) consisting of an airborne digital computer and cockpit displays are presented. The displays provide the pilot with a visual indication of when to manually operate the gear, flaps, and throttles during a delayed flap approach so as to reduce approach time, fuel consumption, and community noise. The AEMS is an independent system that does not interact with other navigation or control systems, and is compatible with manually flown or autopilot coupled approaches. Operational use of the AEMS requires a DME ground station colocated with the flight path reference. Author

**N77-19067#** Illinois Univ., Urbana-Champaign. Savoy Aviation Research Lab.
**A REGRESSION APPROACH TO GENERATE AIRCRAFT PREDICTOR INFORMATION**
Paul D. Gallaher, Robert A. Hunt, and Robert C. Williges Jul. 1976 20 p refs
(Contract N00014-76-C-0081; NR Proj. 196-133)
(AD-A030942; ARL-76-11/ONR-76-2) Avail: NTIS HC A02/MF A01 CSCL 01/4

A predictor display shows the human operator future consequences of his immediate control inputs. A contact analog aircraft display is described in which an airplane-like predictor symbol depicts future airplane position and orientation. The standard method for obtaining the predictor information is to use a complete, fast-time model of the controlled vehicle. An alternative approach is presented in this paper in which least-squares, first-order, linear approximations for each of the six degrees of freedom of aircraft motion were calculated. Thirteen variables representing changes in positions and rate of change of positions were selected as parameters for the prediction equations. Separate sets of equations were determined for 7, 14, and 21 seconds prediction times and continuous, 1, and 3 seconds control neutralization assumption times. The advantages and disadvantages of this regression approach are discussed. Author (GRA)

# 07 AIRCRAFT PROPULSION AND POWER

Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and on-board auxiliary power plants for aircraft.

For related information see also *20 Spacecraft Propulsion and Power, 28 Propellants and Fuels,* and *44 Energy Production and Conversion.*

**N77-19068*#** Kanner (Leo) Associates, Redwood City, Calif.
**LEAKAGE FLOW IN THERMAL TURBO-MACHINES AS THE ORIGIN OF VIBRATION-EXCITING LATERAL FORCES**
K. Urlichs Washington NASA Mar. 1977 35 p refs Transl. into ENGLISH from Ing.-Arch. (West Germany), v. 45, no. 3, 1976 p 193-208
(Contract NASw-2790)
(NASA-TT-F-17409) Avail: NTIS HC A03/MF A01 CSCL 21E

The characteristics of leakage flow in the case of an eccentric rotor position are investigated, taking into account the geometry of clearance relations, the basic equations of the stream tubes, pressure distribution in the clearance area and parameter studies related to leakage flow. The correctness of the derived computational procedure is demonstrated with the aid of an experimental investigation involving a test turbine. Author

**N77-19069*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
**ANALYSIS OF TURBOFAN PROPULSION SYSTEM WEIGHT AND DIMENSIONS**
Mark H. Waters and Edward T. Schairer Jan. 1977 65 p refs
(NASA-TM-X-73199; A-6890) Avail: NTIS HC A04/MF A01 CSCL 21E

Weight and dimensional relationships that are used in aircraft preliminary design studies are analyzed. These relationships are relatively simple to prove useful to the preliminary designer, but they are sufficiently detailed to provide meaningful design tradeoffs. All weight and dimensional relationships are developed from data bases of existing and conceptual turbofan engines. The total propulsion system is considered including both engine and nacelle, and all estimating relations stem from physical principles, not statistical correlations. Author

**N77-19070*#** Detroit Diesel Allison, Indianapolis, Ind.
**DETAILED DESIGN OF A QUIET HIGH FLOW FAN**
J. D. Soltau, M. J. Orelup, A. A. Beguhn, F. M. Wiles, and M. J. Anderson Feb. 1977 229 p refs
(Contract NAS3-19433)
(NASA-CR-135126; EDR-9071) Avail: NTIS HC A11/MF A01 CSCL 21E

A single stage fan was designed to demonstrate the noise abatement properties of near-sonic inlet flow and long-chord stator vanes for the reduction of both upstream and downstream propagated fan source noise. It is designed to produce a pressure ratio of 1.653:1 with an adiabatic efficiency of 83.9%. The fan has a 508 mm inlet diameter with a hub/tip ratio of 0.426 and a design tip speed of 533.4 m/sec. The design inlet specific flow rate is 219.71 kg/sec sq m and there are 10 tandem stator vanes with a combined aspect ratio of 0.54. Author

**N77-19071*#** General Electric Co., Cincinnati, Ohio. Aircraft Engine Group.
**THRUST REVERSER DESIGN STUDIES FOR AN OVER-THE-WING STOL TRANSPORT**
R. C. Ammer and H. D. Sowers Mar. 1977 67 p refs.
(Contract NAS2-9254)
(NASA-CR-151958; R77-AEG190) Avail: NTIS HC A04/MF A01 CSCL 21E

Aerodynamic and acoustics analytical studies were conducted to evaluate three thrust reverser designs for potential use on commercial over-the-wing STOL transports. The concepts were: (1) integral D nozzle/target reverser, (2) integral D nozzle/top arc cascade reverser, and (3) post exit target reverser integral with wing. Aerodynamic flowpaths and kinematic arrangements for each concept were established to provide a 50% thrust reversal capability. Analytical aircraft stopping distance/noise trade studies conducted concurrently with flow path design showed that these high efficiency reverser concepts are employed at substantially reduced power settings to meet noise goals of 100 PNdB on a 152.4 m sideline and still meet 609.6 m landing runway length requirements. From an overall installation standpoint, only the integral D nozzle/target reverser concept was found to penalize nacelle cruise performance; for this concept a larger nacelle diameter was required to match engine cycle effective area demand in reverse thrust. Author

**N77-19072#** Colt Industries, Inc., West Hartford, Conn. Chandler Evans Control Systems Div.
**ENGINE EVALUATION OF ADVANCED TECHNOLOGY CONTROL COMPONENTS Final Report, 7 Mar. 1974 - 1 Feb. 1976**
T. Morrison and A. H. White Aug. 1976 179 p refs
(Contract DAAJ02-74-C-0020; DA Proj. 1F2-62209-AH-76)
(AD-A029371; USAAMRDL-TR-76-17) Avail: NTIS HC A09/MF A01 CSCL 21/5

This report describes the results of a design, fabrication, bench test, and evaluation of an engine-mounted advanced technology gas turbine engine control system on which development was started under previous Army contracts. The control system comprises a full-authority electronic computer module, a fuel metering and inlet guide vane actuator module, a high-speed fuel pump and alternator module, a radiation pyrometer for blade temperature limiting, and other required sensors. The control modules are evaluated on an experimental Army gas turbine engine (STAGG) which was under development at Pratt and Whitney Florida Research and Development Corporation. Tests of the engine-mounted system were conducted in two phases. An environmental phase allowed the control components to be debugged and evaluated over the full power range of the engine while the engine was being controlled by a test stand control system. The second phase of testing demonstrated active control of the engine. All of the engine-mounted control testing was conducted in accordance with the planned engine test schedule on a noninterference basis. Approximately 44 hours of engine-mounted testing were accumulated, and about 8.6 of these hours included active engine control. During this testing, all of the control modules were successfully evaluated including the control of engine accelerations, decelerations, speed governing, inlet guide vane scheduling and ignition. GRA

**N77-19073#** Calspan Corp., Buffalo, N.Y.
**INVESTIGATION OF ROTATING STALL PHENOMENA IN AXIAL FLOW COMPRESSORS. VOLUME 2: INVESTIGATION OF ROTOR-STATOR INTERACTION NOISE AND LIFTING SURFACE THEORY FOR A ROTOR Final Report, 1 May 1973 - 31 May 1976**
John A. Lordi, Gregory F. Homicz, Gary R. Ludwig, Joseph P. Nenni, and John C. Erickson Jun. 1976 193 p refs
(Contract F33615-73-C-2046; AF Proj. 3066)
(AD-A030070; CALSPAN-XE-5315-a-12-Vol-2; AFAPL-TR-76-48-Vol-2) Avail: NTIS HC A09/MF A01 CSCL 21/5

This report presents the results of a research program that had two major objectives. The first objective was the development of a prototype rotating stall control system which was tested both on a low speed rig and a J-85-5 engine. The second objective was to perform fundamental studies of the flow mechanisms that produced rotating stall, surge and noise in axial flow compressors and therby obtain an understanding of these phenomena that would aid attaining the first objective. The work is reported in three separate volumes. Volume I covers the fundamental theoretical and experimental studies of rotating stall; Volume 2 covers the theoretical and experimental studies of discrete-tone aerodynamic noise generation mechanisms in axial flow compressors; and Volume 3 covers the development and testing of a prototype rotating stall control system on both the low speed test rig and the J-85-5 engine. Author (GRA)

**N77-19074#** Naval Aviation Integrated Logistic Support Center, Patuxent River, Md.
**AN INVESTIGATION OF THE NAVY OIL ANALYSIS PROGRAM (NOAP) AS APPLIED TO JET AIRCRAFT ENGINES AND ACCESSORIES Interim Report**
Charles W. Chandler, Jr. 27 May 1976 40 p refs
(AD-A030787; NAILSC-03-41) Avail: NTIS HC A03/MF A01 CSCL 11/8

An investigation of the current Navy Oil Analysis Program has been conducted with the intent of increasing the efficiency of the program in the prediction of jet engine failure. A comprehensive review of the available literature concerning current oil analysis systems was made in conjunction with interviews of both military and commercial personnel. The conclusion drawn from this evaluation is that the current spectrometric methods used by the Navy are capable of effectively determining amount and composition of the contamination particles in lubricating oils; however, this determination is limited to particles under 8 microns (approximately). Also, spectrometric analysis cannot identify the shape, size, or the probable wear mechanism which created the particles. Since catastrophic failures are quite often characterized by the sudden appearance of particles greater than 8 microns, it was evident that some supplemental analysis would be of considerable value. The research conducted indicated that, due to technical and economic reasons, ferrography is the most promising method to supplement spectrometry for oil analysis. (A specific operational example is provided.) The recommendation is to conduct a pilot project to concurrently operate and evaluate a spectrograph and a ferrograph to determine their complementary capabilities. Author (GRA)

**N77-18997#** Southampton Univ. (England). Institute of Sound and Vibration Research.
**JET NOISE**
M. J. Fisher and C. L. Morfey *In* AGARD Aerodynamic Noise, Jan. 1977 23 p refs (For primary document see N77-18994 10-01)
Avail: NTIS HC A14/MF A01

**N77-18998#** Rolls-Royce Ltd., Derby (England).
**GAS TURBINE ENGINE EXHAUST NOISE**
Kenneth W. Bushell *In* AGARD Aerodynamic Noise, Jan. 1977 35 p refs (For primary document see N77-18994 10-01)
Avail: NTIS HC A14/MF A01

**N77-18999#** Rolls-Royce Ltd., Derby (England).
**FAN NOISE**
B. W. Lowrie *In* AGARD Aerodynamic Noise, Jan. 1977 21 p refs (For primary document see N77-18994 10-01)
Avail: NTIS HC A14/MF A01

**N77-19002#** Southampton Univ. (England). Inst. for Sound and Vibration Research.
**AIRCRAFT FLYOVER MEASUREMENTS**
Michael E. House *In* AGARD Aerodynamic Noise, Jan. 1977 14 p refs (For primary document see N77-18994 10-01)
Avail: NTIS HC A14/MF A01

**N77-19003#** Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
**COMPARISON OF DIFFERENT METHODS OF LOCALISATION AND IDENTIFICATION OF NOISE SOURCES IN TURBOJET ENGINES [COMPARISON DE DIFFERENTES METHODS DE LOCALISATION ET D'IDENTIFICATION DE SOURCES SONORES DE TURBOREACTEURS]**
Mariano Perulli *In* AGARD Aerodynamic Noise, Jan. 1977 13 p refs In FRENCH (For primary document see N77-18994

10-01)
Avail: NTIS HC A14/MF A01

# 08 AIRCRAFT STABILITY AND CONTROL

Includes aircraft handling qualities; piloting; flight controls; and autopilots.

**N77-19075#** Army Materiel Systems Analysis Agency, Aberdeen Proving Ground, Md.
**COMPUTER PROGRAMS FOR HELICOPTER AERODYNAMIC STABILITY EVALUATION**
Robert R. Oehrli Aug. 1976 111 p refs
(DA Proj. 1R7-65706-M-541)
(AD-A030816; AMSAA-TR-130) Avail: NTIS HC A06/MF A01 CSCL 01/3

The three equations of motion for helicopters are reviewed for both pitch and roll. These include provisions for a simplified second order stability augmentation system. Two methods of calculating the required stability derivatives and solution of the equations of motion in terms of period and time to damp or time histories for various control motions are shown.
Author (GRA)

# 09 RESEARCH AND SUPPORT FACILITIES (AIR)

Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tube facilities; and engine test blocks.

For related information see also *14 Ground Support Systems and Facilities (Space)*.

**N77-19076*** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
**ROTATING LAUNCH DEVICE FOR A REMOTELY PILOTED AIRCRAFT Patent**
Thomas J. Gregory, inventor (to NASA) Issued 2 Nov. 1976 6 p Filed 28 Aug. 1975
(NASA-Case-ARC-10979-1; US-Patent-3,989,206; US-Patent-Appl-SN-608483; US-Patent-Class-244-63; US-Patent-Class-124-6) Avail: US Patent Office CSCL 01E

A method and apparatus for launching a remotely piloted aircraft is disclosed, wherein the aircraft is revolved about a fixed pivot point until a predetermined speed is reached whereupon the vehicle is released from the launching apparatus. The vehicle is attached to one end of a rotatable arm, the imbalance on the arm being counteracted by a counter weight attached to the opposite end. The counter weight is released from the arm at the same time as the aircraft so as to avoid structural damage to the apparatus caused by rotation in the unbalanced condition. The arm is oriented such that it rotates in a plane inclined obliquely to the local gravitational field of the launch site.
Official Gazette of the U.S. Patent Office

**N77-19077*#** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
**MULTI-PURPOSE WIND TUNNEL REACTION CONTROL MODEL BLOCK Patent Application**
Henry S. Dresser (Rockwell Intern. Corp, Downey, Calif.) and Joseph J. Daileda, inventors (to NASA) (Rockwell Intern. Corp., Downey, Calif.) Filed 11 Feb. 1977 14 p
(Contract NAS9-14000)
(NASA-Case-MSC-19706-1; US-Patent-Appl-SN-767911) Avail: NTIS HC A02/MF A01 CSCL 14B

A reaction control system nozzle block is provided for testing the response characteristics of space vehicles to a variety of reaction control thruster configurations. A pressurized air system is connected with the supply lines which lead to the individual jet nozzles. Each supply line terminates in a compact cylindrical plenum volume, axially perpendicular and adjacent to the throat of the jet nozzle. The volume of the cylindrical plenum is sized to provide uniform thrust characteristics from each jet nozzle irrespective of the angle of approach of the supply line to the plenum.
NASA

**N77-19078#** California Univ., Livermore. Lawrence Livermore Lab.
**HIGH-PRESSURE SAFETY AT THE LAWRENCE LIVERMORE LABORATORY, AN ENERGY RESEARCH FACILITY**
W. A. Burton 6 May 1976 23 p Presented at Intern. Joint Pressure Vessels and Piping and Petrol. Mech. Eng. Conf., Mexico City, 19-23 Sep. 1976 Revised
(Contract W-7405-eng-48)
(UCRL-77724-Rev-1; Conf-760905-8) Avail: NTIS HC A02/MF A01

A high pressure safety program geared towards preventing lost time high pressure accidents is studied. Program organization, personnel training and qualification, pressure vessel criteria and documentation, and pressure testing and inspection are discussed.
ERA

**N77-19079#** Los Alamos Scientific Lab., N.Mex.
**COMPUTER-ASSISTED ESTIMATING FOR THE LOS ALAMOS SCIENTIFIC LABORATORY**
James E. Spooner Feb. 1976 15 p
(Contract W-7405-eng-36)
(LA-6254-MS) Avail: NTIS HC A02/MF A01

An analysis is made of the cost estimating system currently in use at the Los Alamos Scientific Laboratory (LASL), and the benefits of computer assistance are evaluated. A computer-assisted estimating system (CAE) is proposed for LASL. CAE decreases turnaround and provides more flexible response to management requests for cost information and analyses. It enhances value optimization at the design stage, improves cost control and change order justification, and widens the use of cost information in the design process.
ERA

**N77-19080#** Los Alamos Scientific Lab., N.Mex.
**PULSED HIGH-ENERGY RADIOGRAPHIC MACHINE EMITTING X-RAYS: PHERMEX**
Richard D. Dick 1976 29 p refs Presented at Am. Soc. for Nondestructive Testing Flash X-ray Symp., Houston, Tex., 27-30 Sep. 1976
(Contract W-7405-eng-48)
(LA-UR-76-1426; Conf-760914-2) Avail: NTIS HC A03/MF A01

The PHERMEX facility that is used to provide radiography of explosives and explosive-driven systems is described. This facility allows precision flash radiography of large objects containing high atomic number materials. The facility consists of a high-current, three-cavity, 27-MeV linear electron accelerator; a 13.5-MW radiofrequency power source; a timing, firing, and signal detection system; and a data acquisition system. PHERMEX was built in the early part of the 1960s to complement other hydrodynamics facilities at Los Alamos and to implement studies related to shock waves, detonation, and other hydrodynamic phenomena. The attractive features of PHERMEX are the following: very intense submicrosecond 27-MeV bremsstrahlung radiation; 1-mm diam spot size; 100 R at 1 m from a 200-ns pulse; precise determination of edges, discontinuities, and areal mass distribution; and flash radiographs of large explosive systems close to the target.
ERA

**N77-19081#** Mound Lab., Miamisburg, Ohio.
**DEVELOPMENT AND EVALUATION OF DOP GENERATORS FOR SPECIAL USES**
Robert L. Mielke 18 Jun. 1976 17 p refs
(Contract E(33-1)-GEN-53)
(MLM-2306) Avail: NTIS HC A02/MF A01

Cold generators to produce background aerosol concentration for testing filters in clean room operations are described. Two simple, portable, air operated aerosol generators were built and tested to determine their performance. The results show the particle size distribution is in the 0.3 to 0.8 micrometers range, and 1/4 or 3/8 in. i.d. tubing to the nozzles is used.
ERA

**N77-19082#** Royal Aircraft Establishment, Bedford (England). Structures Dept.

**A CONTROL-SURFACE OSCILLATORY DERIVATIVE RIG FOR USE WITH HALF-MODELS IN HIGH-SPEED WIND TUNNELS**

K. C. Wight and N. C. Lambourne London Aeron. Res. Council 1976 25 p refs Supersedes RAE-TR-75026; ARC-36192 (ARC-CP-1353; RAE-TR-75026; ARC-36192) Avail: NTIS HC A02/MF A01; HMSO £ 1.20; PHI $4.90

A rig for the measurement of control surface oscillatory derivatives on half-models with part or full span controls with a hinge-like sweepback range of -7 deg to +50 deg was developed for use in medium-size high-speed wind tunnels. Instrumentation allows measurements of the normal force, pitching moment, and rolling moment on the model and hinge moment on the control to be made in the presence of high noise levels. Incidence, mean control angle, amplitude, and frequency can be varied. The rig is described in detail, and the methods of calibration and measurement, as well as the experience gained using the rig in two high-speed tunnels are discussed. Author (ESA)

**N77-19083#** Royal Aircraft Establishment, Farnborough (England).

**SIMILARITY REQUIREMENTS FOR FLUTTER AND OTHER AEROELASTIC MODELS IN A CRYOGENIC WIND TUNNEL**

N. C. Lambourne 22 Jun. 1976 13 p refs (RAE-TM-Struct-888; BR53323) Avail: NTIS HC A02/MF A01

A consideration of the requirements for aeroelastic similarity shows that the low working temperature of a cryogenic tunnel and an ability to vary temperature both have potential advantages in regard to the choice of suitable stiffness and density scales for an aeroelastic model. The advantages are incidental to the main purpose of a cryogenic tunnel, which is to achieve high Reynolds numbers. Author (ESA)

**N77-19084#** Dynalectron Corp., Albuquerque, N. Mex. Facilities Services Div.

**THE IMPULSE ACCELERATOR. AN IMPACT SLED FACILITY FOR HUMAN RESEARCH AND SAFETY SYSTEMS TESTING Technical Report, Nov. 1972 - Aug. 1975**

John T. Shaffer Wright-Patterson AFB, Ohio AFML Aug. 1976 87 p refs (Contract F33615-74-C-4050; AF Proj. 7231) (AD-A030534; AMRL-TR-76-8) Avail: NTIS HC A05/MF A01 CSCL 01/2

The AMRL Impulse Accelerator impact test facility serves the needs of the USAF for research and development in crash safety and ejection seat testing. The facility located at Wright-Patterson AFB, Ohio, is used primarily for establishing tolerable human acceleration limits and developing protective restraint concepts. This report is basically an operations manual for the Impulse Accelerator System. It describes the operation and performance of the HYGE actuator, the instrumentation systems, the photo systems, the safety and control systems and the data reduction systems. Also included are descriptions of test set-up procedures and maintenance requirements. Author (GRA)

**N77-19085#** Pritsker and Associates, Inc., West Lafayette, Ind.

**SAINT SIMULATION OF REMOTELY PILOTED VEHICLE/DRONE CONTROL FACILITY: TECHNICAL DOCUMENTATION Final Report, Oct. 1974 - Jun. 1975**

Steven D. Duket, Deborah J. Seifert, and David B. Wortman Jun. 1976 257 p refs (Contract F33615-75-C-5012; AF Proj. 7184) (AD-A029944; AMRL-TR-75-119) Avail: NTIS HC A12/MF A01 CSCL 09/2

A model of a real-time simulation of a Remotely Piloted Vehicle/Drone Control Facility (RPV/DCF) has been constructed using SAINT, a totally digital man-machine modeling and simulation technique. The real-time simulation consists of a mock-up of a DCF, where actual operators control the flight of simulated RPVs through the use of cathode ray tube (CRT) displays of RPV flight paths and parameters. The SAINT model consists of two interacting components. The state variable component of the model duplicates the simulation of RPV flight of the real-time simulation. The task-oriented component represents the control and decision tasks performed by the DCF operators. The interactions between the components include the presentation of mission status information to the operators and the processing of commands sent to the RPVs by the operators. This report describes the technical details of the SAINT model. The SAINT network is presented with a detailed description of each task. The user-written subprograms incorporated in the model are fully defined through verbal descriptions, FORTRAN listings, and variable definitions. Input procedures necessary for the simulation of an RPV/DCF mission are described and illustrated, and example outputs from the SAINT simulation are presented. Author (GRA)

**N77-19086#** National Research Council of Canada, Ottawa (Ontario). Div. of Mechanical Engineering.

**MODEL STUDY OF A PROPOSED ENGINEERING ACOUSTIC RESEARCH FACILITY**

G. W. Johnston, F. Rueter, and M. S. Chappell Jul. 1976 33 p refs (AD-A030639; DME-ME-243; NRC-15480; ISSN-0077-555X) Avail: NTIS HC A03/MF A01 CSCL 20/1

A one-twelfth scale aeroacoustic model of a proposed engineering acoustic research facility has been tested to assess the background noise levels in the anechoic measurement area, and to develop a suitable exhaust collector for deflected jet conditions. The facility comprises an open circuit, open jet wind tunnel with an anechoic space surrounding the test section. Collector configurations with acceptably low background noise and low sensitivity to jet deflection have been defined, but these features were achieved at the expense of some aerodynamic efficiency. Author (GRA)

**N77-19087#** Army Missile Research, Development and Engineering Lab., Redstone Arsenal, Ala.

**OPTICAL MEASUREMENT OF MISSILE WING DEFORMATION IN HIGH VELOCITY TESTS**

Charles R. Christensen, J. Lynn Smith, Terry A. Martin, and Judson R. Griffin 19 Jul. 1976 22 p refs Presented at Army Sci. Conf., West Point, N. Y., 22-25 Jun. 1976 (DA Proj. 1W3-62303-A-214) (AD-A029645; RR-7T-1) Avail: NTIS HC A03/MF A01 CSCL 16/4

Two methods were developed to measure missile wing deformations during rocket sled tests. One technique uses a mirror polished test wing which reflects a grid pattern painted on one of the perpendicular wings. The test wing and grid are both moving at the same velocity, and the reflection of the grid on the test wing can therefore be photographed with the sled test track streak cameras. The displacement of the grid reflection on the deformed wing from that of the undeformed wing determines the angular deformation. The spatial deformation is found by curve fitting from a point of zero deformation. The available streak camera resolution allowed angular deformations of approximately 0.2 deg to be measured, corresponding to a linear spatial displacement of approximately 0.025 inch. This technique was used in Hawk missile tests conducted at the Holloman Air Force Base High Speed Track. Test wing profiles were calculated from streak camera photographs taken at velocities near Mach 2. A Moire analysis technique was also developed which requires ruling the wing with a grid pattern and photographing the ruled wing at two different angles both before and after deformation. Moire fringes formed by superimposing phototransparencies are used to measure displacements. A laboratory demonstration was conducted to demonstrate its feasibility. Author (GRA)

**N77-19088#** Austin Research Engineers, Inc., Tex.

**DATA COLLECTION AND ANALYSIS, RUNWAY 4R-22L, O'HARE INTERNATIONAL AIRPORT Final Report**

Harvey J. Treybig, Harold L. VonQuintus, and B. Frank McCullough Sep. 1976 183 p refs (Contract DACW39-75-C-0090) (AD-A030806; WES-CR-S-76-11) Avail: NTIS HC A09/MF A01 CSCL 01/5

This report documents and discusses data obtained from field studies of continuously reinforced concrete (CRC) airfield pavement. It includes a discussion and analysis of deflection measurements, material properties, traffic distribution, climatological data, and the pavement's physical condition, as they pertain to the design of CRC pavements and overlays. A comparison is

presented between predicted characteristics, developed using the design procedures for CRC pavement, and actual observations made on Runway 4R-22L at O'Hare International Airport. A summary of the analysis is presented which includes conclusions concerning components of the design procedure and a list of recommendations for future revisions and additions to the procedure. Every attempt was made to summarize and establish the initial behavior and performance data of Runway 4R-22L, so that it can be used in future performance studies of CRC airfield pavements. Author (GRA)

**N77-19089#** Army Engineer Waterways Experiment Station, Vicksburg, Miss. Soils and Pavements Lab.
**EVALUATION OF PARAMETERS AFFECTING HORIZONTAL STABILITY OF LANDING MATS Final Report**
Yu T. Chou, Walter R. Barker, and William P. Dawkins Sep. 1976 67 p refs
(DA Proj. 4A7-62719-AT-31)
(AD-A030882; WES-TR-S-76-10) Avail: NTIS HC A04/MF A01 CSCL 01/5

The parameters that affect the horizontal stability of airfield surfacing mats were studied by conducting a series of static full-scale buckling tests in the laboratory using various mats and lay patterns. AM2, XM18, and XM19 mats with simulated waterproofing were used in the testing. The mat test sections ranged from one to five panels wide with widths of up to 36 ft. It was found that the most predominant factor affecting the buckling load was the initial eccentricity characteristic of the mat system. Other factors were panel width, mat unit weight, and formation width. The magnitude of locking angle had no effect on the buckling load but did affect the profile of the buckled wave. The existence of resilient filler in the joints of the waterproofing mats reduced the locking angle but did not increase the buckling load. A series of buckling tests of model AM2 mats of various widths were conducted in the laboratory; the mats were obtained from Utah State University. The results enabled the extrapolation of full-scale mat tests from short widths in the laboratory to airfield widths. GRA

**N77-19090#** Naval Air Engineering Center, Lakehurst, N.J. Engineering Dept.
**METALLURGICAL ANALYSIS OF ARRESTING GEAR DECK PENDANT FAILURES Final Report**
Leonard Moskowitz 8 Oct. 1976 63 p refs
(AD-A031274; NAEC-ENG-7910) Avail: NTIS HC A04/MF A01 CSCL 01/5

A metallurgical investigation was conducted to explain the nature of a failed cross-deck pendant. The pendant had completely parted during the arrestment of an F-4 Aircraft on the USS Franklin D. Roosevelt (CV-42). As part of the investigation, deck-pendants taken from tests conducted by the Naval Air Engineering Center (NAEC) at the Runway Arrested Landing Site (RALS) of the Naval Air Test Facility (NATF) were also examined. These tests were run in an attempt to simulate those conditions which might have led to the cross-deck pendant failure which occurred in the CV-42. The metallurgical studies, along with samples taken from cable qualifications samples supplied by NATF, gave an insight into the causes of cross-deck pendant failures. The results of the studies, along with opinions as to the cause of the CV-42 pendant failure are reported.
Author (GRA)

**N77-19004#** Royal Aircraft Establishment, Farnborough (England).
**GROUND-BASED FACILITIES WITH FORWARD-SPEED REPRESENTATION FOR AIRCRAFT NOISE RESEARCH**
John Williams *In* AGARD Aerodynamic Noise, Jan. 1977 43 p refs (For primary document see N77-18994 10-01)
Avail: NTIS HC A14/MF A01

## 12 ASTRONAUTICS (GENERAL)

For extraterrestrial exploration see *91 Lunar and Planetary Exploration.*

**N77-19091*#** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**THE DEEP SPACE NETWORK Progress Report, Nov. - Dec. 1976**
15 Feb. 1977 277 p refs
(Contract NAS7-100)
(NASA-CR-149668; JPL-PR-42-37) Avail: NTIS HC A13/MF A01 CSCL 14B

A Deep Space Network progress report is presented dealing with in flight project support, tracking and data acquisition research and technology, network engineering, hardware and software implementation, and operations. For individual titles, see N77-19092 through N77-19120.

**N77-19092*#** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**NETWORK FUNCTIONS AND FACILITIES c14**
N. A. Renzetti *In its* The Deep Space Network 15 Feb. 1977 p 1-3 (For primary document see N77-19091 10-12)
Avail: NTIS HC A13/MF A01 CSCL 22D

The objectives, functions, and organization of the Deep Space Network are summarized; deep space station, ground communication, and network operations control capabilities are described.
Author

**N77-19093*#** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**MARK 3-77 DSN COMMAND SYSTEM c17**
W. G. Stinnett *In its* The Deep Space Network 15 Feb. 1977 p 4-11 (For primary document see N77-19091 10-12)
Avail: NTIS HC A13/MF A01 CSCL 17B

A comparison is made with the Mark III-75 System Configuration to explain the implementation required to establish the Mark III-77 System Configuration.

**N77-19094*#** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**VIKING MISSION SUPPORT c14**
D. W. Johnston, T. W. Howe, and G. M. Rockwell *In its* The Deep Space Network 15 Feb. 1977 p 12-25 (For primary document see N77-19091 10-12)
Avail: NTIS HC A13/MF A01 CSCL 22D

Deep Space Network support for the four Viking spacecraft during October and November 1976 is summarized. The period covers the last portion of the prime mission which officially terminated on 15 November 1976 and the start of the Viking extended mission on that date. November also covered the Mars-Sun-Earth superior conjunction period with the rapid degradation of RF link performance resulting in the tapering off and termination of telemetry data coincident with a rapid increase in radio science experiment activity. The various radio science experiments are described in detail and the computer aided countdown program utilized by the tracking stations during the Viking mission is also described. Author

**N77-19095*#** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**INTERMEDIATE DATA RECORD SUPPORT FOR THE VIKING PRIME MISSION c17**
J. A. Swindlehurst *In its* The Deep Space Network 15 Feb. 1977 p 26-34 (For primary document see N77-19091 10-12)
Avail: NTIS HC A13/MF A01 CSCL 17B

The more significant problems encountered in intermediate data records production during the mission are discussed and a definitive statement of the production levels accomplished is given. Author

**N77-19096*#** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**PIONEER MISSION SUPPORT c14**
T. P. Hadamski *In its* The Deep Space Network 15 Feb. 1977 p 35-38 (For primary document see N77-19091 10-12)
Avail: NTIS HC A13/MF A01 CSCL 22D

Some recent activities within the Deep Space Network in support of the Pioneer project's in-flight spacecraft are reported. The amount of tracking coverage provided by the Network and the current status of operational testing of the Mark III Data Subsystems are presented. Author

**N77-19097*#** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**HELIOS MISSION SUPPORT c14**
P. S. Goodwin, E. S. Burke, and T. P. Adamski *In its* The Deep Space Network 15 Feb. 1977 p 39-42 ref (For primary

document see N77-19091 10-12)
Avail: NTIS HC A13/MF A01 CSCL 22D

Activities of the Network Operations organization in support of the Helios project during October and November 1976 is reported. Author

**N77-19098*#** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**A SOLAR PLASMA STREAM MEASURED BY DRVID AND DUAL-FREQUENCY RANGE AND DOPPLER RADIO METRIC DATA** **c92**
F. B. Winn, S. C. Wu, T. A. Komarek, V. W. Lam, H. N. Royden, and K. B. W. Yip *In its* The Deep Space Network 15 Feb. 1977 p 43-54 refs (For primary document see N77-19091 10-12)
Avail: NTIS HC A13/MF A01 CSCL 03B

S- and X-band DRVID, S- and X-band dual-frequency range (SX(p)), and Doppler (SX(p)) measured a 15-fold increase in the line-of-sight electron content of the solar plasma above the normal plasma background. A general increase in the plasma electron content continued for nearly 50 hours: it started about 12:00 (GMT) on 12 March 1976 and continued to grow until 17:00 (GMT) on 14 March. For the next 55 hours, between 17:00 (GMT) on 14 March to 00:54 (GMT) on 17 March, the plasma level diminished as the background level was approached. Not only were the temporal changes and absolute level of the plasma content measured but the measurements were also used to ascertain the mean-plasma-concentration location: it was estimated to be 4.1 light minutes from earth. Author

**N77-19099*#** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**FEASIBILITY STUDY OF FAR-FIELD METHODS FOR CALIBRATING GROUND STATION DELAYS** **c14**
T. Sato *In its* The Deep Space Network 15 Feb. 1977 p 55-56 (For primary document see N77-19091 10-12)
Avail: NTIS HC A13/MF A01 CSCL 22D

The first phase of a study to survey various methods of directly implementing a far-field means of calibrating ranging systems is described. Consideration is given to means of determining test range distances independent of microwave techniques. Author

**N77-19100*#** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**PRELIMINARY DEMONSTRATION OF PRECISION DSN CLOCK SYNCHRONIZATION BY RADIO INTERFEROMETRY** **c14**
W. J. Hurd *In its* The Deep Space Network 15 Feb. 1977 p 57-68 refs (For primary document see N77-19091 10-12)
Avail: NTIS HC A13/MF A01 CSCL 22D

A wideband digital data acquisition system has been developed to measure the clock offsets to the 10-ns accuracy required to facilitate three-way spacecraft ranging, to monitor the hydrogen maser frequency standard rates to 1 part in 10 to the forteenth power and to potentially reduce operational costs by replacing the current DSN operational time sync system. Author

**N77-19101*#** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**RADIO FREQUENCY INTERFERENCE FROM NEAR-EARTH SATELLITES** **c32**
B. K. Levitt and J. R. Lesh *In its* The Deep Space Network 15 Feb. 1977 p 69-77 ref (For primary document see N77-19091 10-12)
Avail: NTIS HC A13/MF A01 CSCL 17B

A pessimistic statistical model was developed for predicting the extent of radio frequency interference (RFI). Based on the assumptions underlying the model, DSN S-band operations can expect one RFI interruption every 4.1 days, with the average incident lasting 24 s. This implies that 52 or more such satellites, with uncorrelated orbital trajectories, will cause in excess of 5 min of RFI per day at a DSN station. Author

**N77-19102*#** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**LOW-NOISE RECEIVERS: MICROWAVE MASER DEVELOPMENT** **c36**
R. Quinn and E. Wiebe *In its* The Deep Space Network 15 Feb. 1977 p 78-82 refs (For primary document see N77-19091 10-12)
Avail: NTIS HC A13/MF A01 CSCL 20E

An S-Band traveling-wave maser with a 2260- to 2400-MHz tuning capability has been built and installed on the 26-m antenna. The traveling-wave maser closed cycle refrigerator package was assembled within a limited time schedule and at low cost to meet the requirements of the very long baseline interferometry validation task. The maser uses a superconducting magnet with a field staggering coil for gain/bandwidth adjustment. The maser pump source is a Gunn effect oscillator with the capability of continuous tuning throughout the entire maser tuning range. The package was assembled from surplus components that have been used previously in the Deep Space Network in a variety of applications. Author

**N77-19103*#** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**ON THE INHERENT INTRACTABILITY OF FINDING GOOD CODES** **c61**
R. J. McEliece and H. C. A. VanTilborg *In its* The Deep Space Network 15 Feb. 1977 p 83-87 refs (For primary document see N77-19091 10-12)
Avail: NTIS HC A13/MF A01 CSCL 09B

The problem of computing the minimum distance of an arbitrary binary linear code is non-polynomial complete. This strongly suggests, but does not imply, that it is impossible to design a computer algorithm for computing the minimum distance of an arbitrary code whose running time is bounded by a polynomial in the number of inputs. Author

**N77-19104*#** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**DSN AUTOMATION** **c60**
R. B. Crow *In its* The Deep Space Network 15 Feb. 1977 p 88-104 (For primary document see N77-19091 10-12)
Avail: NTIS HC A13/MF A01 CSCL 09B

An overall hierarchical automation philosophy along with the results of the radio frequencies automation effort undertaken 2 years ago are summarized. A brief description of each subassembly controller's salient features, the software development process, and the common software used by these controllers will be presented. Comments will be made with respect to the relative advantages of high-level language and assembly language, the operational effectiveness of operator Macro commands, and the program development, and a list of suggested future effort will be given. Author

**N77-19105*#** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**AUTOMATED FOURTH-HARMONIC ANALYZER** **c60**
C. F. Foster *In its* The Deep Space Network 15 Feb. 1977 p 105-111 (For primary document see N77-19091 10-12)
Avail: NTIS HC A13/MF A01 CSCL 09B

The final design of a field portable microprocessor-based, microwave measuring and analysis instrument to be used for S-band transmitter fourth-harmonic power analysis and its impact on X-band reception in a dual S-X-band system is described. Author

**N77-19106*#** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**CONTROL AND COMPUTATION MODULE DEVELOPMENT** **c60**
R. A. Winkelstein *In its* The Deep Space Network 15 Feb. 1977 p 112-117 refs (For primary document see N77-19091 10-12)
Avail: NTIS HC A13/MF A01 CSCL 09B

Software development methods have been investigated and two test bed projects have been chosen to evaluate application techniques of the 8080A and support microcircuits which will satisfy DSN requirements. Final recommendations will reflect successful JPL applications experience. Author

**N77-19107*#** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**STOCHASTIC MODELS FOR SOFTWARE PROJECT MANAGEMENT** **c81**
R. C. Tausworthe *In its* The Deep Space Network 15 Feb. 1977 p 118-126 ref (For primary document see N77-19091 10-12)
Avail: NTIS HC A13/MF A01 CSCL 05A

A method for determining the number and characteristics of milestones to be achieved during a development project is presented in order that effective monitors of progress can be provided. Projections of progress data lead to estimates of the

completion with determinable accuracy, but accuracy imposes a requirement that the number of milestones be inversely proportional to the estimate-error variance, and that the milestones themselves be defined in such a way that each represents approximately the same level of effort to complete. Author

**N77-19108*#** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**WALSH TRANSFORMS AND SIGNAL DETECTION c32**
L. R. Welch *In its* The Deep Space Network 15 Feb. 1977 p 127-131 ref (For primary document see N77-19091 10-12)
Avail: NTIS HC A13/MF A01 CSCL 17B

The detection of signals using Walsh power spectral estimates is analyzed. In addition, a generalization of this method of estimation is evaluated. The conclusion is that Walsh transforms are not suitable tools for the detection of weak signals in noise. Author

**N77-19109*#** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**EVALUATION OF DSN DATA PROCESSING WITH 7200-b/s GCF HIGH-SPEED DATA INTERFACES c60**
H. C. Thorman *In its* The Deep Space Network 15 Jul. 1977 p 132-135 ref (For primary document see N77-19091 10-12)
Avail: NTIS HC A13/MF A01 CSCL 09B

Test results confirm that the Deep Space Station (DSS) and Network Operations Control Center (NOCC) processing of telemetry, command, radio metric, and monitor data with the existing DSN Mark III-75 configuration will be unaffected by the recent change of the Ground Communications Facility (GCF) high-speed data subsystem to a clock rate of 7,200 bits per second. Author

**N77-19110*#** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**BASEBAND RECORDING AND PLAYBACK c17**
S. S. Kent and J. I. Molinder *In its* The Deep Space Network 15 Feb. 1977 p 136-145 refs (For primary document see N77-19091 10-12)
Avail: NTIS HC A13/MF A01 CSCL 17B

Analog recordings of spacecraft telemetry signals are made by Deep Space Network Deep Space Stations to provide backup for both spacecraft and ground station anomalies. The requirements that must be met to insure successful baseband recording and playback are given. Recording and playback procedures are developed to insure that these requirements are met and performance results from tests conducted at the Compatibility Test Area (JPL) are tabulated. Author

**N77-19111*#** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**SIMULATION OF TIME SERIES BY DISTORTED GAUSSIAN PROCESSES c64**
C. A. Greenhall *In its* The Deep Space Network 15 Feb. 1977 p 146-151 refs (For primary document see N77-19091 10-12)
Avail: NTIS HC A13/MF A01 CSCL 12A

Distorted stationary Gaussian process can be used to provide computer-generated imitations of experimental time series. A method of analyzing a source time series and synthesizing an imitation is shown, and an example using X-band radiometer data is given. Author

**N77-19112*#** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**COMPUTER MODELING OF A REGENERATIVE SOLAR-ASSISTED RANKINE POWER CYCLE c44**
F. L. Lansing *In its* The Deep Space Network 15 Feb. 1977 p 152-168 refs (For primary document see N77-19091 10-12)
Avail: NTIS HC A13/MF A01 CSCL 10A

A detailed interpretation of the computer program that describes the performance of one of these cycles; namely, a regenerative Rankine power cycle is presented. Water is used as the working medium throughout the cycle. The solar energy collected at relatively low temperature level presents 75 to 80% of the total heat demand and provides mainly the latent heat of vaporization. Another energy source at high temperature level superheats the steam and supplements the solar energy share. A program summary and a numerical example showing the sequency of computations are included. The outcome from the model comprises line temperatures, component heat rates, specific steam consumption, percentage of solar energy contribution, and the overall thermal efficiency. Author

**N77-19113*#** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**PRECISION INSOLATION MEASUREMENT UNDER FIELD CONDITIONS c92**
M. S. Reid and R. A. Gardner *In its* The Deep Space Network 15 Feb. 1977 p 169-175 refs (For primary document see N77-19091 10-12)
Avail: NTIS HC A13/MF A01 CSCL 03B

Work at the Jet Propulsion Laboratory had resulted in the development of a primary absolute cavity radiometer (PACRAD), which was recently accepted as an international standard of irradiance. The development of an wall-weather, field-worthy solar radiometer based on the PACRAD is discussed, and its calibration stability over a two-year period in the field is described. Author

**N77-19114*#** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**IMPLEMENTATION OF A MAXIMUM LIKELIHOOD CONVOLUTIONAL DECODER IN THE DSN c17**
M. E. Alberda *In its* The Deep Space Network 15 Feb. 1977 p 176-183 refs (For primary document see N77-19091 10-12)
Avail: NTIS HC A13/MF A01 CSCL 17B

The development status of the decoder and the factors which were considered in defining the specific functional requirements are described. The design is discussed to the block diagram level. A description of the detailed design is provided, along with a description of the test software developed and a brief summary of the performance evaluation testing completed so far. Author

**N77-19115*#** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**IMPLEMENTATION OF NEW-GENERATION RECORDERS/REPRODUCERS INTO THE DSN c17**
G. B. Hamilton *In its* The Deep Space Network 15 Feb. 1977 p 184-197 (For primary document see N77-19091 10-12)
Avail: NTIS HC A13/MF A01 CSCL 17B

New-generation recorder/reproducers are being installed in the Pre/Post-Detection Recording Subsystem at DSSs 14 (Goldstone), 43 (Australia), 63 (Spain), and the JPL Compatibility Test Area CTA 21. The performance of these new-generation machines is discussed, and representative corroborating data acquired at CTA 21 are presented. Author

**N77-19116*#** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**CALIBRATION OF BLOCK 4 TRANSLATOR PATH DELAYS AT DSS 14 AND CTA 21 c14**
T. Y. Otoshi, P. D. Batelaan, K. B. Wallace, and F. Ibanez *In its* The Deep Space Network 15 Feb. 1977 p 188-197 refs (For primary document see N77-19091 10-12)
Avail: NTIS HC A13/MF A01 CSCL 22D

The techniques for calibrating the translator path by means of a portable zero delay device are described. In addition, some translator path data taken at DSS 14, Goldstone, over a period of about one year is presented. Author

**N77-19117*#** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**PHASE AND GROUP DELAY OF S-BAND MEGAWATT CASSEGRAIN DIPLEXER AND S-BAND MEGAWATT TRANSMIT FILTER c14**
R. Lay *In its* The Deep Space Network 15 Feb. 1977 p 198-203 refs (For primary document see N77-19091 10-12)
Avail: NTIS HC A13/MF A01 CSCL 22D

The phase characteristics and group delay of the S-band Megawatt Cassegrain Diplexer (MCD) and S-band Megawatt Transmit Filter (MTF) are reported. These phase measurements on the MCD and MTF were done in response to the need to obtain the total DSS hardware ground delay required for very long baseline interferometry and ranging radio metric measurements. Author

**N77-19118*#** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**SOLAR PLASMA: VIKING 1975 INTERPLANETARY SPACECRAFT DUAL-FREQUENCY DOPPLER DATA c92**
S. C. Wu and F. B. Winn *In its* The Deep Space Network 15 Feb. 1977 p 204-223 refs (For primary document see N77-19091 10-12)
Avail: NTIS HC A13/MF A01 CSCL 03B

Viking 1975 interplanetary S- and X-band Doppler data are surveyed. These data show consistency with differenced range

versus integrated Doppler (DRVID) data when there is solar plasma and with Faraday rotation data otherwise. An increase of solar plasma effects with decreasing sun-earth-probe (SEP) angle (approaching Mars orbit insertion) is demonstrated. The 2-way/3-way data indicate a homogeneous solar plasma structure over a 8,000-km spread. Occasional cycle slips in the data are pinpointed and tabulated. Author

**N77-19119*#** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**A COMPREHENSIVE TWO-WAY DOPPLER NOISE MODEL FOR NEAR-REAL-TIME VALIDATION OF DOPPLER DATA c14**
A. L. Berman *In its* The Deep Space Network 15 Feb. 1977 p 224-238 refs (For primary document see N77-19091 10-12)
Avail: NTIS HC A13/MF A01 CSCL 22D

Doppler noise generated within the tracking system is modeled as a function of the dominant variable-Doppler sample interval. Additionally, the relationship between media noise and Doppler samples interval is empirically determined, and the ratio of media noise for S- and X-band downlinks is solved for. These functional relationships are incorporated into the previous media noise modeling to obtain a comprehensive two-way Doppler noise model. Author

**N77-19120*#** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**DSN SYSTEM PERFORMANCE TEST DOPPLER NOISE MODELS; NONCOHERENT CONFIGURATION c14**
R. Bunce *In its* The Deep Space Network 15 Feb. 1977 p 239-271 refs (For primary document see N77-19091 10-12)
Avail: NTIS HC A13/MF A01 CSCL 22D

The newer model for variance, the Allan technique, now adopted for testing, is analyzed in the subject mode. A model is generated (including considerable contribution from the station secondary frequency standard), and rationalized with existing data. The variance model is definitely sound; the Allan technique mates theory and measure. The mean-frequency model is an estimate; this problem is yet to be rigorously resolved. The unaltered defining expressions are noncovergent, and the observed mean is quite erratic. Author

**N77-19121*#** National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
**APOLLO-SOYUZ TEST PROJECT: COMPOSITE OF MSFC FINAL SCIENCE REPORT**
Jan. 1977 469 p refs Original contains color illustrations (NASA-TM-X-73360) Avail: NTIS HC A20/MF A01 CSCL 22A

Experimental procedures of nine experiments conducted during the Apollo-Soyuz Test Project mission from July 15th to July 24th, 1975 are presented. Conclusions and recommendations based on these experiments are given. For individual titles, see N77-19122 through N77-19130.

**N77-19122*#** National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
**COLUMN ELECTROPHORESIS ON THE APOLLO-SOYUZ TEST PROJECT. EXPERIMENT MA-011 c25**
R. E. Allen, P. H. Rhodes, Milan Bier (VA Hospital, Tucson, Ariz.), Fortunato J. Micale (Lehigh Univ., Bethlehem, Pa.), John W. Vanderhoff (Lehigh Univ., Bethlehem, Pa.), Carel J. VanOss (State University of New York at Buffalo), P. E. Bigazzi (Conn. Univ. Health Center, Farmington), G. H. Barlow (Abbott Labs., North Chicago, Ill.), G. V. F. Seaman (Oreg. Univ. Health Scis. Center, Portland), and R. J. Knox (Oreg. Univ. Health Scis. Center, Portland) *In its* Apollo-Soyuz Test Project Jan. 1977 68 p refs (For primary document see N77-19121 10-12)
Avail: NTIS HC A20/MF A01 CSCL 07D

The experimental procedures of the electrophoresis of erythrocytes, lymphocytes and kidney cells on the Apollo Soyuz Test Project are given. L.S.

**N77-19123*#** Max-Planck-Institut fuer Biochemie, Martinsried bei Muenchen (West Germany).
**ELECTROPHORESIS EXPERIMENT. EXPERIMENT MA-014 c25**
K. H. Hannig *In* NASA. Marshall Space Flight Center Apollo-Soyuz Test Project Jan. 1977 38 p ref (For primary document see N77-19121 10-12)
Avail: NTIS HC A20/MF A01 CSCL 07D

A continuous free-flow electrophoresis study was conducted during the Apollo-Soyuz Test Project Mission to investigate and evaluate the increase in sample flow rate and sample resolution achievable in space. The electrophoresis equipment was designed for the separation of four mixtures of biological cells with variable sample flow rates, buffer flow rates, and electric field gradients. Separation quality was assessed by measuring the light from a quartz lamp through the electrophoresis channel and onto a photodiode system. The data evaluation indicates that all monitored systems operated correctly during the experiment. The optical system produced a light that was too bright to discern true cell distributions, but final analysis of scientific data by computer processing shows the expected distribution of separated cells. Author

**N77-19124*#** Oak Ridge National Lab., Tenn. Solid State Div.
**SURFACE TENSION INDUCED CONVECTION IN ENCAPSULATED LIQUID METALS IN A MICROGRAVITY ENVIRONMENT. EXPERIMENT MA-041 Final Report**
R. E. Reed, W. Uelhoff (Institut fur Festkoerperforschung, Kernforschungsanlage Julich, BRD), and H. L. Adair *In* NASA. Marshall Space Flight Center Apollo-Soyuz Test Project Jan. 1977 87 p refs Original contains color illustrations (For primary document see N77-19121 10-12)
Avail: NTIS HC A20/MF A01 CSCL 22A

The experiment was designed to detect possible convection caused by a steplike compositional variation in a liquid metal in a microgravity environment. Wetting and nonwetting ampoules were used to try to determine the extent of the stirring effects if they were present. Since stirring effects can be caused by temperature gradients, the temperature gradients were minimized. Steplike compositional variation was created by pressure bonding a lead-0.05 atom percent gold alloy to pure lead. Two diffusion temperatures (923 K and 723 K) were used; if no stirring effects were present, it was hoped that the liquid diffusion parameters for gold in lead could be obtained. Two identifical experimental arrangements were used to compare the transport mechanisms of gold in liquid lead in unit gravity and microgravity environments. Author

**N77-19125*#** National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
**MONOTECTIC AND SYNTECTIC ALLOYS. EXPERIMENT MA-044**
L. L. Lacy and C. Y. Aug *In its* Apollo-Soyuz Test Project Jan. 1977 51 p refs (For primary document see N77-19121 10-12)
Avail: NTIS HC A20/MF A01 CSCL 22A

The flight test furnace run of the monotectic and syntectic alloys experiment was successfully performed during the Apollo-Soyuz Test Project mission in July 1975. Examination of the returned sample cartridges and the formal comparative characterization of the low-g and one-g processed samples of lead-zinc and aluminum antimonide were completed. The results for aluminum antimonide show that polycrystalline and multiphased material can be homogenize in space under low-g conditions. Microstructural study on the lead-zinc flight samples shows that complete interdiffusion of lead and zinc had not been achieved, even though the flight data indicated a soak temperature in the miscible region that was 40 K above the published consolute temperature. Author

**N77-19126*#** Massachusetts Inst. of Tech., Cambridge.
**QUANTITATIVE DETERMINATION OF ZERO-GRAVITY EFFECTS ON ELECTRONIC MATERIALS PROCESSING GERMANIUM CRYSTAL GROWTH WITH SIMULTANEOUS INTERFACE DEMARCATION. EXPERIMENT MA-060**
H. C. Gatos and A. F. Witt *In* NASA. Marshall Space Flight Center Apollo-Soyuz Test Project Jan. 1977 65 p refs (For primary document see N77-19121 10-12)
Avail: NTIS HC A20/MF A01 CSCL 22A

Experiment MA-060 was designed to establish the crystal growth and segregation characteristics of a melt in a directional solidification configuration under near zero-g conditions. The interface demarcation technique was incorporated into the experiment since it constitutes a unique tool for recording the morphology of the growth rate throughout solidification, and for

establishing an absolute time reference framework for all stages of the solidification process. An extensive study was performed of the germanium crystals grown during the Apollo-Soyuz Test Project mission. It was found that single crystal growth was achieved and that the interface demarcation functioned successfully. There was no indication that convection driven by thermal or surface tension gradients was present in the melt. The gallium segregation, in the absence of gravity, was found to be fundamentally different in its initial and its subsequent stages from that of the ground-based tests. None of the existing theoretical models for growth and segregation can account for the observed segregation behavior in the absence of gravity.
Author

**N77-19127*#** Grumman Aerospace Corp., Bethpage, N.Y.
**ZERO-G PROCESSING OF MAGNETS. EXPERIMENT MA-070**
D. J. Larson, Jr. *In* NASA. Marshall Space Flight Center Apollo-Soyuz Test Project Jan. 1977 53 p refs (For primary document see N77-19121 10-12)
Avail: NTIS HC A20/MF A01 CSCL 22A

The magnetic compounds under study, manganese-bismuth (MnBi) copper-cobalt-cerium [(Cu,Co)5Ce], are representative of magnetic alloy systems that have the potential for the development of high coercive strength and a high energy product. The samples of 50 at. % bismuth and 50 at. % manganese solidified in the low-g environment demonstrated a substantial improvement in the macroscopic chemical homogeneity. The bismuth/manganese-bismuth directionally solidified eutectic flight samples exhibited marked superior magnetic properties. Intrinsic coercive strengths in excess of 185 Koe have been measured in the low-g processed samples at 77 K. The average value of inductance was improved by 76 percent, and the energy product was improved by 57 percent. Additional results indicate that, in the near-absence of the gravitational body force, contained fluids will assume a lowest energy configuration that differs significantly from that found terrestrially.
Author

**N77-19128*#** Rensselaer Polytechnic Inst., Troy, N.Y.
**CRYSTAL GROWTH FROM THE VAPOR PHASE. EXPERIMENT MA-085**
H. Wiedemeier *In* NASA. Marshall Space Flight Center Apollo-Soyuz Test Project Jan. 1977 40 p refs (For primary document see N77-19121 10-12)
Avail: NTIS HC A20/MF A01 CSCL 22A

The positive effects of microgravity on crystal quality and the fundamental properties of the vapor transport reaction were established by analyzing the results of three transport experiments on multicomponent systems performed during the Apollo-Soyuz Test Project mission. The systems employed were GeSe0.99Te0.01-GeI4(A), GeS0.98Se0.02-GeCl4(B), and GeS-GeCl4-Ar (C). The crystallographic analysis is based on a direct comparison of space and ground-based (prototype) crystals employing X-ray diffraction, microprobe, microscopic, and chemical etching techniques. The results demonstrate a considerable improvement of the space-grown crystals in terms of chemical and crystalline homogeneity, surface morphology, and bulk perfection relative to ground specimens.
Author

**N77-19129*#** California Univ., Los Angeles.
**ZERO-GRAVITY GROWTH OF NaCl-LiF EUTECTIC. EXPERIMENT MA-131**
A. S. Yue, C. W. Yeh, and B. K. Yue *In* NASA. Marshall Space Flight Center Apollo-Soyuz Test Project Jan. 1977 27 p refs (For primary document see N77-19121 10-12)
Avail: NTIS HC A20/MF A01 CSCL 22A

Continuous and discontinuous lithium fluoride fibers embedded in a sodium chloride matrix were produced in space and on earth, respectively. The production of continuous fibers in an eutectic mixture was attributed to the absence of convection current in the liquid during solidification in space. Image transmission and optical transmittance measurements of transverse sections of the space-grown and earth-grown ingots were made with a light microscope and a spectrometer. It was found that better optical properties were obtained from samples grown in space. This was attributed to a better alignment of lithium fluoride fibers along the growth direction.
Author

**N77-19130*#** National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
**GERMANIUM-SILICON SOLID SOLUTIONS**
V. S. Zemskov, V. N. Kubasov, I. N. Belokurova, A. N. Titkov, I. L. Shulpina, V. I. Safarov, and N. B. Guseva *In its* Apollo-Soyuz Test Project Jan. 1977 36 p refs (For primary document see N77-19121 10-12)
Avail: NTIS HC A20/MF A01 CSCL 22A

An experiment on melting and directional crystallization of an antimony (Sb) doped germanium silicon (GeSi) solid solution was designed for the Apollo-Soyuz Test Project (ASTP) to study the possibility of using zero-g conditions for obtaining solid-solution monocrystals with uniformly distributed components. Crystallization in the zero-g environment did not occur under ideal stationary growth and segregation conditions. Crystallization under zero-g conditions revealed the heterogeneous nature of Si and Sb distribution in the cross sections of crystals. The presence of the radial thermal gradient in the multipurpose furnace could be one of the reasons for such Si and Sb distribution. The structure of space-grown crystals correlates with the nature of heterogeneities of Si and Sb distribution in crystals. The type of surface morphology and the contour observed in space-grown crystals were never observed in ground-based crystals and indicate the absence of wetting of the graphitized walls of the ampoule by the melt during melting and crystallization.
Author

**N77-19131*#** TRW Defense and Space Systems Group, Redondo Beach, Calif. Systems Analysis Section.
**FORMULATION OF CONSUMABLES MANAGEMENT MODELS. CONSUMABLES FLIGHT PLANNING WORKSHEET UTILIZATION**
C. M. Newman 25 Feb. 1977 27 p refs
(Contract NAS9-14264)
(NASA-CR-151223; TRW-26821-H013-R0-00) Avail: NTIS HC A03/MF A01 CSCL 22A

The updated and reformatted consumables flight planning worksheet is documented. An instruction set for applying the worksheet, and a sample application of the worksheet is disclosed. The particular application is for the STS interfacing with sortie payloads and typifies the interfacing of the delivery system and payloads.
Author

## 13 ASTRODYNAMICS

Includes powered and free-flight trajectories; and orbit and launching dynamics.

No abstracts in this category

## 14 GROUND SUPPORT SYSTEMS AND FACILITIES (SPACE)

Includes launch complexes, research and production facilities; ground support equipment, mobile transporters; and simulators.

For related information see also *09 Research Support Facilities (Air)*.

**N77-19132*#** Westinghouse Electric Corp., Pittsburgh, Pa.
**DESIGN, FABRICATION AND TEST OF PROTOTYPE FURNACE FOR CONTINUOUS GROWTH OF WIDE SILICON RIBBON Final Report**
C. S. Duncan and R. G. Seidensticker Dec. 1976 117 p refs
(Contract NAS3-19439)
(NASA-CR-135165; Rept-76-9C4-SIGRO-R1) Avail: NTIS HC A06/MF A01 CSCL 14B

A program having the overall objective of growing wide, thin silicon dendritic web crystals quasi-continuously from a semi-automated facility is discussed. The design considerations and fabrication of the facility as well as the test and operation phase are covered; detailed engineering drawings are included

as an appendix. During the test and operation phase of the program, more than eighty growth runs and numerous thermal test runs were performed. At the conclusion of the program, 2.4 cm wide web was being grown at thicknesses of 100 to 300 micrometers. As expected, the thickness and growth rate are closely related. Solar cells made from this material were tested at NASA-Lewis and found to have conversion efficiencies comparable to devices fabricated from Czochralski material.
Author

**N77-19133*#** Kanner (Leo) Associates, Redwood City, Calif.
**THE ARABIC SPACE CENTER**
M. Nassif Washington NASA Mar. 1977 18 p Transl. into ENGLISH from Alarabi (Kuwait), no. 219, Feb. 1977 18 p
(Contract NASw-2790)
(NASA-TT-F-17527) Avail: NTIS HC A02/MF A01 CSCL 14B

Projects utilizing data from ERTS and LANDSAT satellites and from a Modular Multispectral Scanner airplane are outlined, but no detailed results are given. Future plans include construction of a station for direct reception of satellite data somewhere in the Arab world.
Author

**N77-19092*#** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**NETWORK FUNCTIONS AND FACILITIES**
N. A. Renzetti *In its* The Deep Space Network 15 Feb. 1977 p 1-3 (For primary document see N77-19091 10-12)
Avail: NTIS HC A13/MF A01 CSCL 22D

**N77-19094*#** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**VIKING MISSION SUPPORT**
D. W. Johnston, T. W. Howe, and G. M. Rockwell *In its* The Deep Space Network 15 Feb. 1977 p 12-25 (For primary document see N77-19091 10-12)
Avail: NTIS HC A13/MF A01 CSCL 22D

**N77-19096*#** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**PIONEER MISSION SUPPORT**
T. P. Hadamski *In its* The Deep Space Network 15 Feb. 1977 p 35-38 (For primary document see N77-19091 10-12)
Avail: NTIS HC A13/MF A01 CSCL 22D

**N77-19097*#** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**HELIOS MISSION SUPPORT**
P. S. Goodwin, E. S. Burke, and T. P. Adamski *In its* The Deep Space Network 15 Feb. 1977 p 39-42 ref (For primary document see N77-19091 10-12)
Avail: NTIS HC A13/MF A01 CSCL 22D

**N77-19099*#** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**FEASIBILITY STUDY OF FAR-FIELD METHODS FOR CALIBRATING GROUND STATION DELAYS**
T. Sato *In its* The Deep Space Network 15 Feb. 1977 p 55-56 (For primary document see N77-19091 10-12)
Avail: NTIS HC A13/MF A01 CSCL 22D

**N77-19100*#** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**PRELIMINARY DEMONSTRATION OF PRECISION DSN CLOCK SYNCHRONIZATION BY RADIO INTERFEROMETRY**
W. J. Hurd *In its* The Deep Space Network 15 Feb. 1977 p 57-68 refs (For primary document see N77-19091 10-12)
Avail: NTIS HC A13/MF A01 CSCL 22D

**N77-19116*#** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**CALIBRATION OF BLOCK 4 TRANSLATOR PATH DELAYS AT DSS 14 AND CTA 21**
T. Y. Otoshi, P. D. Batelaan, K. B. Wallace, and F. Ibanez *In its* The Deep Space Network 15 Feb. 1977 p 188-197 refs (For primary document see N77-19091 10-12)
Avail: NTIS HC A13/MF A01 CSCL 22D

**N77-19117*#** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**PHASE AND GROUP DELAY OF S-BAND MEGAWATT CASSEGRAIN DIPLEXER AND S-BAND MEGAWATT TRANSMIT FILTER**
R. Lay *In its* The Deep Space Network 15 Feb. 1977 p 198-203 refs (For primary document see N77-19091 10-12)
Avail: NTIS HC A13/MF A01 CSCL 22D

**N77-19119*#** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**A COMPREHENSIVE TWO-WAY DOPPLER NOISE MODEL FOR NEAR-REAL-TIME VALIDATION OF DOPPLER DATA**
A. L. Berman *In its* The Deep Space Network 15 Feb. 1977 p 224-238 refs (For primary document see N77-19091 10-12)
Avail: NTIS HC A13/MF A01 CSCL 22D

**N77-19120*#** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**DSN SYSTEM PERFORMANCE TEST DOPPLER NOISE MODELS; NONCOHERENT CONFIGURATION**
R. Bunce *In its* The Deep Space Network 15 Feb. 1977 p 239-271 refs (For primary document see N77-19091 10-12)
Avail: NTIS HC A13/MF A01 CSCL 22D

## 15 LAUNCH VEHICLES AND SPACE VEHICLES

Includes boosters; manned orbital laboratories; reusable vehicles; and space stations.

**N77-19134*#** Boeing Co., Kent, Wash.
**LONG LIFE TESTING OF SPARE MARINER VENUS '67 HARDWARE Final Report**
S. W. Silverman 21 Sep. 1976 55 p ref
(Contract JPL-952600)
(NASA-CR-149810; D180-19361-1) Avail: NTIS HC A04/MF A01 CSCL 22B

The faultless performance of the Mariner Venus '67 Power Conditioning Electronics (PCE) throughout six years of continuous operation in a simulated space environment is reported. Weekly functional tests supplemented by daily monitoring verified that the PCE equipment can perform to its intended functions for at least six years without apparent performance degradation. Performance throughout the test period was very stable, there are no circuit or redundancy improvements to be considered. When the equipment was examined after the test was completed, there was no evidence of any physical damage nor any difficulty in disconnecting the wiring connectors.
Author

**N77-19135*#** McDonnell-Douglas Corp., Huntington Beach, Calif.
**SPACE STATION ANALYSIS STUDY. PART 2, VOLUME 1: EXECUTIVE SUMMARY Final Report**
28 Feb. 1977 43 p
(Contract NAS9-14958)
(NASA-CR-151225; MDC-G6715) Avail: NTIS HC A03/MF A01 CSCL 22A

Objectives of the space station program requiring the support of man in space, either in the shuttle sortie mode or in extended duration facilities are identified and analyzed. A set of functional requirements was derived to identify specific technology advancement needs, tests to be conducted, and processes to be developed. Program options are summarized for. (1) satellite power system; (2) earth services; (3) space cosmological research and development; (4) space processing and manufacturing; (5) multidiscipline science laboratory; (6) sensor development facility; (7) living and working in space; and (8) orbital depot.
Author

**N77-19136*#** McDonnell-Douglas Corp., Huntington Beach, Calif.
**SPACE STATION SYSTEMS ANALYSIS STUDY. PART 2, VOLUME 2 Final Report**
28 Feb. 1977 251 p refs
(Contract NAS9-14958)
(NASA-CR-151226; MDC-G6715-Pt-2-Vol-2) Avail: NTIS HC A12/MF A01 CSCL 22A

Specific system options are defined and identified for a cost effective space station capable of orderly growth with regard to both function and orbit location. Selected program options are analyzed and configuration concepts are developed to meet objectives for the satellite power system, earth servicing, space processing, and supporting activities. Transportation systems are analyzed for both LEO and GEO orbits.
Author

**N77-19137*#** McDonnell-Douglas Corp., Huntington Beach, Calif.
**SPACE STATION SYSTEMS ANALYSIS STUDY. PART 2, VOLUME 3: APPENDIXES, BOOK 1. PROGRAM REQUIREMENTS DOCUMENTATION Final Report**
28 Feb. 1977 256 p
(Contract NAS9-14958)
(NASA-CR-151227; MDC-G6715-Pt-2-Vol-3) Avail: NTIS HC A12/MF A01 CSCL 22A

The objective elements representative of the kinds of space activities that will be supported by the space construction base (SCB) are discussed in (1) a brief mission overview including the primary purpose and general objectives; (2) descriptions of the processes involved (where applicable), the mission hardware, the principal activities to be undertaken, the test requirements, and the principal tests; and (3) the SCB requirements including such items as special devices (e.g., fabrication modules, assembly or construction fixtures, cranes, and airlocks), power, data management and communications, waste management, environmental control, safety, and logistics. Each program option is then described in terms of the objective elements it supports, its orbit, the general makeup of the SCB, the transportation approach, and the program schedule goals. The specific requirements that are imposed on the SCB in order to support program option L are given. Author

**N77-19138*#** McDonnell-Douglas Corp., Huntington Beach, Calif.
**SPACE STATION SYSTEMS ANALYSIS STUDY. PART 2, VOLUME 3: APPENDIXES, BOOK 2: SUPPORTING DATA (1 THROUGH 6) Final Report**
28 Feb. 1977 271 p refs
(Contract NAS9-14958)
(NASA-CR-151228; MDC-G6715-Pt-2-Vol-3) Avail: NTIS HC A12/MF A01 CSCL 22A

Options and designs are analyzed for the space construction base, environmental control and life support systems, high voltage array, cranes, low cost modules, and vehicle mass properties. Author

**N77-19139*#** McDonnell-Douglas Corp., Huntington Beach, Calif.
**SPACE STATION SYSTEMS ANALYSIS STUDY. PART 2, VOLUME 3: APPENDIXES, BOOK 2: SUPPORTING DATA (7 THROUGH 18) Final Report**
28 Feb. 1977 444 p refs
(Contract NAS9-14958)
(NASA-CR-151229; MDC-G6715-Pt-2-Vol-3) Avail: NTIS HC A19/MF A01 CSCL 22A

Topics discussed include: (1) design considerations for a MARS sample return laboratory module for space station investigations; (2) crew productivity as a function of work shift arrangement; (3) preliminary analysis of the local logistics problem on the space construction base; (4) mission hardware construction operational flows and timelines; (5) orbit transfer vehicle concept definition; (6) summary of results and findings of space processing working review; (7) crew and habitability subsystem (option L); (8) habitability subsystem considerations for shuttle tended option L; (9) orbiter utilization in manned sortie missions; (10) considerations in definition of space construction base standard module configuration (option L); (11) guidance, control, and navigation subsystems; and (12) system and design tradeoffs. Author

**N77-19140*#** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**VIKING 75 ORBITER SYSTEM TEST AND LAUNCH OPERATIONS. VOLUME 1: SYSTEM TEST Final Report**
31 Jan. 1977 89 p refs Sponsored by NASA
(NASA-CR-149806; JPL-611-132-Vol-1) Avail: NTIS HC A05/MF A01 CSCL 22D

The activities and results of the test and operations program performed on the three orbiter spacecraft (VO-1, VO-2, and VO-3) are described. The period from receipt of orbiter hardware at the Spacecraft Assembly Facility at JPL through shipment of the orbiter systems and support equipment to the Air Force Eastern Test Range is covered. Author

**N77-19141*#** National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
**TECHNICAL ASSESSMENT OF HIGH ENERGY ASTRONOMY OBSERVATORY-B (HEAO-B) ATTITUDE CONTROL AND DETERMINATION SUBSYSTEM (ACDS)**
Dec. 1976 301 p refs
(NASA-TM-X-73366) Avail: NTIS HC A14/MF A01 CSCL 22B

The HEAO-B ACDS Review Team completed its four month assessment of the technical adequacy of the HEAO-B ACDS. As a result of its detailed analysis of the ACDS, the team found no reason why the ACDS will not perform its specified functions adequately. However, 23 concerns that point to potential difficulties were found and delineated; 18 of these are in the form of review item discrepancies. Author

**N77-19142#** Sandia Labs., Albuquerque, N.Mex.
**FLIGHT-TEST BASE PRESSURE MEASUREMENTS IN TURBULENT FLOW**
Bruce M. Bulmer Jun. 1976 18 p refs
(Contract AT(29-1)-789)
(SAND-76-0267) Avail: NTIS HC A02/MF A01

Flight test base pressure data obtained from relatively sharp (5 to 6 percent nose bluntness), slender (9-degree half angle) conical reentry vehicles are discussed. The measurements are presented as a function of Mach number to emphasize base pressure variations throughout the range M/sub infinity/ = 0.5 to 15 in turbulent boundary layer flow conditions. A satisfactory data correlation is developed in terms of local cone parameters to assess the sensitivity of base pressure to nose bluntness and cone angle for vehicles characterized by very low heatshield ablation rates. Comparisons of experimental pressure coefficient (base drag) with limited numerical solutions are included. ERA

**N77-19143#** Steria Automatisme et Ingenierie, Paris (France).
**METHOD FOR ESTABLISHING A SATELLITE BROADCASTING PLAN Final Report [ETUDE DE METHODE POUR L'ETABLISSEMENT D'UN PLAN DE RADIODIFFUSION PAR SATELLITES]**
Jun. 1976 104 p In FRENCH
(Contract ESA-SC/78-HQ)
(ESA-CR(P)-843) Avail: NTIS HC A06/MF A01

A program was developed for generating satellite broadcasting plans which satisfy interference constraints, i.e., the positive interference margins in the case of a preponderant interferer. It also produces the interferences margin in the most pessimistic case of cumulation of all maximum interference at the same point. The grouping of satellites in orbit can be accounted for. The validity of results obtained depends on that of the data and principally the discrimination matrices. The latter take into account geographical data, transmitting antenna diagrams and gains, antenna calculation methods, and power. ESA

**N77-19144#** Universite Catholique de Louvain (Belgium). Faculte des Sciences Appliquees.
**STUDY OF STATE ESTIMATION AND PARAMETER IDENTIFICATION APPLIED TO SPINNING FLEXIBLE SATELLITES. PART 1: DYNAMICS**
P. Y. Willems, Ph. Boland, D. A. Johnson, and J.-C. Samin Jan. 1976 129 p refs 3 Vol.
(Contract ESTEC-2163/74-AK)
(ESA-CR(P)-868-Pt-1) Avail: NTIS HC A07/MF A01

Methods used in two computer programs for dynamic simulation of a particular deformable satellite, GEOS 4, are presented. General considerations are given on dynamics of spinning deformable systems. A multibody approach is adopted to determine the various parameters in the equations of motion and the equilibrium conditions. These considerations are applied to GEOS. A general method for equilibrium synthesis is described in order to obtain all the possibly stable equilibium states and their stability for a system having the nominal inertia configuration of GEOS. Deformation modes of cables are taken into consideration. Knowing the modes, all the parameters of the dynamic equations can be determined, and the dynamic features of the simulation programs can be compared. It is shown that the satellite's motion can be described by a model composed of two rigid cables with tip masses. This model has seven degrees of freedom including two rigid modes. ESA

**N77-19145#** Universite Catholique de Louvain (Belgium). Faculte des Sciences Appliquees.
**STUDY OF STATE ESTIMATION AND PARAMETER IDENTIFICATION APPLIED TO SPINNING FLEXIBLE SATELLITES. PART 2: ESTIMATION AND IDENTIFICATION**
P. Y. Willems, G. Campion, and D. A. Johnson Jan. 1976 104 p refs 3 Vol.
(Contract ESTEC-2163/74-AK)
(ESA-CR(P)-868-Pt-2) Avail: NTIS HC A06/MF A01

A dynamic model of the GEOS satellite was developed; it is composed of a main body and two rigidified cables with tip masses and has a total of seven degrees of freedom including two rigid modes. The amplitude of the modes is estimated and parameters appearing in the equations, which are directly relating to the physical parameters of the satellite, are corrected in order to improve the estimation and check the evolution of the system. It is assumed that the general orientation is known or provided by a low frequency filter using data furnished by earth and star sensors. A fast filter using high frequency information from magnetometers and accelerometers is considered. Two different identification schemes were analyzed: the extended Kalman filter and a method based on sequential decision techniques. ESA

**N77-19146#** Universite Catholique de Louvain (Belgium). Faculte des Sciences Appliquees.
**STUDY OF STATE ESTIMATION AND PARAMETER IDENTIFICATION APPLIED TO SPINNING FLEXIBLE SATELLITES. PART 3: USER'S GUIDE FOR NUMERICAL PROGRAMMES**
P. Y. Willems, G. Campion, D. A. Johnson, and J.-C. Samin Jan. 1976 132 p 3 Vol.
(Contract ESTEC-2163/74-AK)
(ESA-CR(P)-868-Pt-3) Avail: NTIS HC A07/MF A01

Numerical programs are described relating to the dynamic model of the GEOS satellite, and its state estimation and parameter identification, assuming a model consisting of a main body and two rigidified cables with tip masses, and having a total of seven degrees of freedom, including two rigid modes. ESA

**N77-19147#** Societe Nationale Industrielle Aerospatiale, Cannes (France). Div. Systemes Balistiques et Spatiaux.
**STUDY OF ATTITUDE CONTROL SYSTEMS USING THE ESA DIGITAL ONBOARD COMPUTER, VOLUME 2 Final Report [ETUDE DE SYSTEMES DE CONTROLE D'ATTITUDE UTILISANT LE CALCULATEUR EMBARQUE DE L'ESA]**
1976 192 p refs In FRENCH 2 Vol.
(Contract ESTEC-2103/73)
(Rept-600-CA/69-Vol-2; ESA-CR(P)-869-Vol-2) Avail: NTIS HC A09/MF A01

Illustrations and annexes related to the investigation of onboard computers for satellite attitude and orbit control are presented. ESA

# 16 SPACE TRANSPORTATION

Includes passenger and cargo space transportation e.g., shuttle operations; and rescue techniques.

For related information see also *03 Air Transportation and Safety* and *85 Urban Technology and Transportation.*

**N77-19148*#** Vought Corp., Dallas, Tex.
**SPACE SHUTTLE CAVITY ASSESSMENT TEST PROGRAM Final Report**
P. B. Scheps 31 Dec. 1976 96 p refs
(Contract NAS9-10534)
(NASA-CR-151221; T169-66) Avail: NTIS HC A05/MF A01 CSCL 22B

In order to obtain basic radiation properties of the radiator/payload bay door cavity, three tests were conducted on a full-size structural simulator of the cavity. There were three tests conducted: (1) CATA used for determination of exchange factors, absorbed solar flux, and door covering influences, (2) quartz lamp array calibrated to provide IR flux distribution on CATA, and (3) retest with radiometer array for background flux measurement. Author

**N77-19149*#** Vought Corp., Dallas, Tex.
**FLASH EVAPORATOR SYSTEMS TEST Final Report**
J. B. Dietz 23 Dec. 1976 178 p refs
(Contract NAS9-10534)
(NASA-CR-151222; Rept-2-53230/6R-3353) Avail: NTIS HC A09/MF A01 CSCL 22B

A flash evaporator heat rejection system representative of that proposed for the space shuttle orbiter underwent extensive system testing at the NASA Johnson Space Center (JSC) to determine its operational suitability and to establish system performance/operational characteristics for use in the shuttle system. During the tests the evaporator system demonstrated its suitability to meet the shuttle requirements by: (1) efficient operation with 90 to 95% water evaporation efficiency, (2) control of outlet temperature to 40 + or - 2 F for partial heat load operation, (3) stability of control system for rapid changes in Freon inlet temperature, and (4) repeated dormant-to-active device operation without any startup procedures. Author

**N77-19150*#** TRW Defense and Space Systems Group, Redondo Beach, Calif.
**MISSION CONTROL COMMUNICATIONS INTERFACE REQUIREMENTS STUDY, SPACE TRANSPORTATION SYSTEM, VOLUME 1 Final Report**
23 Mar. 1976 36 p refs
(Contract NAS9-14709)
(NASA-CR-151231; TRW-28042-H007-R0-00-Vol-1) Avail: NTIS HC A03/MF A01 CSCL 22A

Communications traffic models required by the STS Operator to satisfy the operational requirements and concepts were developed. Detailed requirements for the ground system required for flight control of the STS and interface with Payload Operations Control Centers were constructed. Author

**N77-19151*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
**NASA/ESA CV-990 SPACELAB SIMULATION. APPENDIXES: C, DATA-HANDLING: PLANNING AND IMPLEMENTATION; D, COMMUNICATIONS; E, MISSION DOCUMENTATION Final Report**
John O. Reller, Jr. Sep. 1976 144 p refs
(NASA-TM-X-73182; A-6738) Avail: NTIS HC A07/MF A01 CSCL 22B

Data handling, communications, and documentation aspects of the ASSESS mission are described. Most experiments provided their own data handling equipment, although some used the airborne computer for backup, and one experiment required real-time computations. Communications facilities were set up to simulate those to be provided between Spacelab and the ground, including a downlink TV system. Mission documentation was kept to a minimum and proved sufficient. Examples are given of the basic documents of the mission. Author

**N77-19152*#** Chrysler Corp., New Orleans, La. Aero/Hydrodynamics Group.
**METHODS FOR DATA REDUCTION AND LOADS ANALYSIS OF SPACE SHUTTLE SOLID ROCKET BOOSTER MODEL WATER IMPACT TESTS Final Report**
Sep. 1976 262 p refs
(Contract NAS8-28988)
(NASA-CR-150206; TN-FT-76-4) Avail: NTIS HC A12/MF A01 CSCL 20H

The methodology used to predict full scale space shuttle solid rocket booster (SRB) water impact loads from scale model test data is described. Tests conducted included 12.5 inch and 120 inch diameter models of the SRB. Geometry and mass characteristics of the models were varied in each test series to reflect the current SRB baseline configuration. Nose first and tail first water entry modes were investigated with full-scale initial impact vertical velocities of 40 to 120 ft/sec, horizontal velocities of 0 to 60 ft/sec., and off-vertical angles of 0 to plus or minus 30 degrees. The test program included a series of tests with scaled atmospheric pressure. Author

# 17 SPACECRAFT COMMUNICATIONS, COMMAND AND TRACKING

Includes telemetry; space communications networks; astronavigation; and radio blackout.

For related information see also *04 Aircraft Communications and Navigation* and *32 Communications*.

**N77-19153#** Sandia Labs., Albuquerque, N.Mex.
**WIRELESS CONTROL SYSTEM FOR A TRANSMITTER BURIED IN THE EARTH**
Thurlow W. H. Caffey Jun. 1976 33 p refs
(Contract AT(29-1)-789)
(SAND-76-0135) Avail: NTIS HC A03/MF A01

The design and field testing of a system with which to turn on and off a telemetry transmitter mounted within a buried earth penetrator are described. The system is designed to operate at depths of up to 50 m in soils with a conductivity of up to 100 mS/m. ERA

**N77-19154#** Centre National d'Etudes Spatiales, Toulouse (France).
**MISSILE TRACKING: EFFECT OF SYSTEMATIC MEASUREMENT ERRORS ON THE RETRIEVAL OF THE VELOCITY VECTOR COMPONENTS [TRAJECTOGRAPHIE D'ENGINS. INFLUENCE D'ERREURS SYSTEMATIQUES DE MESURE SUR LA RESTITUTION DES COMPOSANTES DU VECTEUR VITESSE]**
Jean Saint-Etienne Sep. 1976 15 p ref In FRENCH; ENGLISH summary
(CNES-NT-47) Avail: NTIS HC A02/MF A01

Missile tracking from a launch range is dealt with for retrieval of the velocity vector of a missile, constant errors on positioning measurements could vanish by subtraction in the computing process of the velocity vector. It is however demonstrated, for an elementary case, that bias errors on positioning data induce some effects on the quality of the retrieval of the velocity vector components. As the demonstration can be generalized, some recommendations are inferred concerning the operation of a tracking system on a launch range. Author (ESA)

**N77-19155#** Centre National d'Etudes Spatiales, Toulouse (France).
**GEOLE PROJECT: DISTANCE MEASUREMENT. COMPARISON OF VARIOUS DISTANCE MEASUREMENT VIDEO SIGNALS [PROJET GEOLE: MESURE DISTANCE. COMPARAISON DE DIFFERENTS SIGNAUX VIDEO DE MESURE DISTANCE]**
Jean-Bernard Deloly Sep. 1976 37 p In FRENCH; ENGLISH summary
(CNES-NT-48) Avail: NTIS HC A03/MF A01

Under the hypotheses established during the initial studies of the GEOLE project, a comparison is made of the telemetry video signals considered therein. All these signals are a combination of a 1 MHz clock (H), which is used for the accurate distance measurement, and a lower frequency signal, which is phase coherent with H and is used to suppress the ambiguity. Several kinds of composition of the latter signal are compared. It appears that the best one is the sequential transmission of clocks the frequencies of which are $1/2^n$ MHz (n=2,...,8) and which are derived by division from H. Author (ESA)

**N77-19156#** Centre National d'Etudes Spatiales, Toulouse (France).
**PN CODE TELEMETRY WITH PHASE COHERENT SUBCARRIER MULTIPLEX [TELEMETRES A CODES PN ET A MULTIPLEX DE SOUS-PORTEUSES COHERENTES EN PHASES]**
Jean Bernard Deloly Oct. 1976 45 p refs In FRENCH; ENGLISH summary
(CNES-NT-54) Avail: NTIS HC A03/MF A01

A synthesis of the different telemetry signals is presented using PN codes or multiplex of phase coherent subcarriers, which were investigated during localization studies: PN received by a delay lock loop, and combination of the two signals: a clock (H) the frequency of which is determined by the accuracy required; and a signal the use of which is to suppress the ambiguity; it is derived from H and phase coherent with it (this signal may be a PN code, or a combination of PN codes; or a multiplex of subcarriers derived from H by successive divisions). Author (ESA)

**N77-19157#** Naval Surface Weapons Center, Dahlgren, Va.
**CELEST COMPUTER PROGRAM FOR COMPUTING SATELLITE ORBITS Final Report**
James W. OToole Oct. 1976 202 p
(AD-A030478; NSWC/DL-TR-3565) Avail: NTIS HC A10/MF A01 CSCL 09/2

The CELEST Computer Program uses raw Doppler data to determine satellite orbits. It provides diagnostic information on the quality of the orbits and the data used in producing those orbits. The basic technique employed is one of weighted least squares where the data is edited and weighted within the program. An iterative capability exists for nonlinear problems. Trajectories are formed by directly integrating the equations of motion in an inertial frame. The force equation has components due to earth, sun and moon gravity, solar radiation, thrust, atmospheric drag, solar and lunar tidal distortion. A satellite frequency offset error can be determined, and the program has the facility for determining unknown receiver locations. The computer program occupies 130 octal units of memory, is structured as nine major overlays, and is completely written in FORTRAN. The program is primarily operated on a sixty hit CDC 6700 computer. Author (GRA)

**N77-19093*#** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**MARK 3-77 DSN COMMAND SYSTEM**
W. G. Stinnett *In its* The Deep Space Network 15 Feb. 1977 p 4-11 (For primary document see N77-19091 10-12)
Avail: NTIS HC A13/MF A01 CSCL 17B

**N77-19095*#** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**INTERMEDIATE DATA RECORD SUPPORT FOR THE VIKING PRIME MISSION**
J. A. Swindlehurst *In its* The Deep Space Network 15 Feb. 1977 p 26-34 (For primary document see N77-19091 10-12)
Avail: NTIS HC A13/MF A01 CSCL 17B

**N77-19110*#** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**BASEBAND RECORDING AND PLAYBACK**
S. S. Kent and J. I. Molinder *In its* The Deep Space Network 15 Feb. 1977 p 136-145 refs (For primary document see N77-19091 10-12)
Avail: NTIS HC A13/MF A01 CSCL 17B

**N77-19114*#** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**IMPLEMENTATION OF A MAXIMUM LIKELIHOOD CONVOLUTIONAL DECODER IN THE DSN**
M. E. Alberda *In its* The Deep Space Network 15 Feb. 1977 p 176-183 refs (For primary document see N77-19091 10-12)
Avail: NTIS HC A13/MF A01 CSCL 17B

**N77-19115*#** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**IMPLEMENTATION OF NEW-GENERATION RECORDERS/REPRODUCERS INTO THE DSN**
G. B. Hamilton *In its* The Deep Space Network 15 Feb. 1977 p 184-197 (For primary document see N77-19091 10-12)
Avail: NTIS HC A13/MF A01 CSCL 17B

# 18 SPACECRAFT DESIGN, TESTING AND PERFORMANCE

Includes spacecraft thermal and environmental control; and attitude control.

For life support systems see *54 Man/System Technology and Life Support*. For related information see also *05 Aircraft Design, Testing and Performance* and *39 Structural Mechanics*.

**N77-19158*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**MASS STUDY FOR MODULAR APPROACHES TO A SOLAR ELECTRIC PROPULSION MODULE**
G. Richard Sharp, James E. Cake, Jon C. Oglebay, and Francis J. Shaker Mar. 1977 37 p refs
(NASA-TM-X-3473; E-8800) Avail: NTIS HC A03/MF A01 CSCL 21C

The propulsion module comprises six to eight 30-cm thruster and power processing units, a mercury propellant storage and distribution system, a solar array ranging in power from 18 to 25 kW, and the thermal and structure systems required to support the thrust and power subsystems. Launch and on-orbit configurations are presented for both modular approaches. The propulsion module satisfies the thermal design requirements of a multimission set including: Mercury, Saturn, and Jupiter orbiters, a 1-AU solar observatory, and comet and asteroid rendezvous. A detailed mass breakdown and a mass equation relating the total mass to the number of thrusters and solar array power requirement is given for both approaches. Author

**N77-19159*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**DESIGN, FABRICATION, AND STRUCTURAL TESTING OF A LIGHTWEIGHT SHADOW SHIELD FOR DEEP-SPACE APPLICATION**
David Miao, James R. Barber, and Richard L. DeWitt Washington Mar. 1977 51 p refs
(NASA-TN-D-8319; E-8889) Avail: NTIS HC A04/MF A01 CSCL 22A

Two full-scale, lightweight, double-sheeted shadow shields were developed as the primary element of a deep-space thermal protection system for liquid-hydrogen propellant tankage. The thermal and mechanical considerations used in s, the method of fabrication, and the environmental testing results on a prototype shield are discussed. Testing consisted of a transient cooldown period, a prolonged cold soak, and a transient warmup. The mechanical and thermal analyses used in the shield design are sufficient to produce a lightweight rugged shadow shield assembly that is structurally adequate for its intended application. Author

**N77-19160*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**CHARGING CHARACTERISTICS OF MATERIALS: COMPARISON OF EXPERIMENTAL RESULTS WITH SIMPLE ANALYTICAL MODELS**
Carolyn K. Purvis, N. John Stevens, and Jon C. Oglebay 1977 29 p refs Presented at the Spacecraft Charging Technol. Conf., Colorado Springs, Colo., 27-29 Oct. 1976; cosponsored by NASA and AF
(NASA-TM-X-73606; E-8970-2) Avail: NTIS HC A03/MF A01 CSCL 22B

An understanding of the behavior of materials, of dielectrics in particular, under charged particle bombardment is essential to the prediction and prevention of the adverse effects of spacecraft charging. A one-dimensional model for charging of samples in a test facility was used in conjunction with experimental data taken to develop 'material charging characteristics' for silvered Teflon. These characteristics were then used in a one-dimensional model for charging in space to examine expected response. Relative charging rates as well as relative charging levels for silvered Teflon and metal are discussed. Author

**N77-19161#** TRW Systems, Redondo Beach, Calif.
**SOME CONSIDERATIONS IN SHIELDING OF SPACECRAFT AGAINST THE EFFECTS OF EMP**
T. J. Sheppard May 1976 15 p refs Sponsored by ERDA (PEM-49) Avail: NTIS HC A02/MF A01

The basic shielding characteristics involving enclosure of the sensitive equipment into solid metal boxes, or other containment by various metallic screens, meshes, conduits, or other such devices are discussed. In satellites, considerations of weight and flexibility usually dominate the design requirements, and braided cable becomes a good cable shielding choice. ERA

# 19 SPACECRAFT INSTRUMENTATION

For related information see also *06 Aircraft Instrumentation* and *35 Instrumentation and Photography*.

**N77-19162*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**PREDICTION AND MEASUREMENT RESULTS OF RADIATION DAMAGE TO CMOS DEVICES ON BOARD SPACECRAFT**
E. G. Stassinopoulos, V. Danchenko, R. A. Cliff, M. Sing, G. J Brucker (RCA Astro Electronics Div., Princeton, N. J.), and R. S. Ohanian (RCA Astro Electronics Div., Princeton, N. J.) Feb. 1977 5 p Presented at IEEE Ann. Conf. on Nucl. and Space Radiation Effects, Williamsburg, Va., Dec. 1976 Submitted for publication
(NASA-TM-X-71278; X-601-77-33) Avail: NTIS HC A02/MF A01 CSCL 22B

All the currently available results of the flight experiment for all the individually instrumented 130 transistors, relating to both biased and unbiased n- and p-channel RCA and -channel AMI devices were presented. The predictions of dose levels based on a detailed analysis of the space radiation environment as encountered by Explorer-55 and calculated by one dimensional slab geometry, and three dimensional spherical geometry were cited. Author

# 20 SPACECRAFT PROPULSION AND POWER

Includes main propulsion systems and components e.g., rocket engines; and spacecraft auxiliary power sources.

For related information see also *07 Aircraft Propulsion, 28 Propellants and Fuels*, and *44 Energy Production and Conversion*.

**N77-19163*#** Aerojet Liquid Rocket Co., Sacramento, Calif.
**ANALYSIS OF ROCKET ENGINE INJECTION COMBUSTION PROCESSES Final Report**
J. W. Salmon and D. H. Saltzman Feb. 1977 43 p refs
(Contract NAS8-31531)
(NASA-CR-150200; FR-31531F-2) Avail: NTIS HC A03/MF A01 CSCL 21H

Mixing methodology improvement for the JANNAF DER and CICM injection/combustion analysis computer programs was accomplished. ZOM plane prediction model development was improved for installation into the new standardized DER computer program. An intra-element mixing model developing approach was recommended for gas/liquid coaxial injection elements for possible future incorporation into the CICM computer program. Author

**N77-19164*#** Lockheed Missiles and Space Co., Huntsville, Ala. Research and Engineering Center.
**ASSESSMENT OF ANALYTICAL TECHNIQUES FOR PREDICTING SOLID PROPELLANT EXHAUST PLUMES AND PLUME IMPINGEMENT ENVIRONMENTS**
James A. Tevepaugh, Sheldon D. Smith, and Morris M. Penny Jan. 1977 137 p refs
(Contract NAS9-14845)
(NASA-CR-151216; LMSC-HREC-TR-D497079) Avail: NTIS HC A07/MF A01 CSCL 21H

An analysis of experimental nozzle, exhaust plume, and exhaust plume impingement data is presented. The data were obtained for subscale solid propellant motors with propellant Al loadings of 2, 10 and 15% exhausting to simulated altitudes of 50,000, 100,000 and 112,000 ft. Analytical predictions were made using a fully coupled two-phase method of characteristics numerical solution and a technique for defining thermal and pressure environments experienced by bodies immersed in two-phase exhaust plumes. Author

**N77-19165*#** Hercules, Inc., Cumberland, Md. Allegany Ballistics Lab.
**FILAMENT WOUND ROCKET MOTOR CHAMBERS Final Report**
Sep. 1976 68 p refs Prepared for JPL
(Contracts NAS7-100; JPL-954136)
(NASA-CR-149861; AO-8251-130-01-014) Avail: NTIS HC A04/MF A01 CSCL 21H

The design, analysis, fabrication and testing of a Kevlar-49/HBRF-55A filament wound chamber is reported. The chamber was fabricated and successfully tested to 80% of the design burst pressure. Results of the data reduction and analysis from the hydrotest indicate that the chamber design and fabrication techniques used for the chamber were adequate and the chamber should perform adequately in a static test. Author

**N77-19166*#** Fairchild Republic Co., Farmingdale, N.Y.
**HIGH ENERGY DENSITY CAPACITORS FOR VACUUM OPERATION WITH A PULSED PLASMA LOAD Final Report**
William J. Guman 1 Mar. 1976 59 p refs Prepared for JPL
(Contracts NAS7-100; JPL-953656)
(NASA-CR-149813) Avail: NTIS HC A04/MF A01 CSCL 21C

Results of the effort of designing, fabricating, and testing of a 40 joules/lb (88.2 joules/Kg) high voltage energy storage capacitor suitable for operating a pulsed plasma thruster in a vacuum environment for millions of pulses are presented. Using vacuum brazing and heli-arc welding techniques followed by vacuum and high pressure helium leak tests it was possible to produce a hermetically sealed relatively light weight enclosure for the dielectric system. An energy density of 40 joules/lb was realized with a KF-polyvinylidene fluoride dielectric system. One capacitor was D.C. life tested at 4 KV (107.8 joules/lb) for 2,000 hours before it failed. Another exceeded 2,670 hours without failure at 38.3 joules/lb. Pulse life testing in a vacuum exceeded 300,000 discharges with testing still in progress. The D.C. life test data shows a small decrease in capacitance and an increase in dissipation factor with time. Heat transfer from the load to the capacitor must also be considered besides the self-heat generated by the capacitor. Author

**N77-19167*#** Hughes Research Labs., Malibu, Calif.
**ADVANCED PROPULSION CONCEPTS STUDY: COMPARATIVE STUDY OF SOLAR ELECTRIC PROPULSION AND LASER ELECTRIC PROPULSION Final Report**
Robert L. Forward Jun. 1975 83 p ref Prepared for JPL
(Contracts NAS7-100; JPL-954085)
(NASA-CR-149802) Avail: NTIS HC A05/MF A01 CSCL 21C

Solar electric propulsion (SEP) and laser electric propulsion (LEP) was compared. The LEP system configuration consists of an 80 kW visible laser source on earth, transmitting via an 8 m diameter adaptively controlled phased array through the atmosphere to a 4 m diameter synchronous relay mirror that tracks the LEP spacecraft. The only significant change in the SEP spacecraft for an LEP mission is the replacement of the two 3.7 m by 33.5 m solar cell arrays with a single 8 m diameter laser photovoltaic array. The solar cell array weight is decreased from 320 kg to 120 kg for an increase in payload of 200 kg and a decrease in specific mass of the power system from 20.5 kg/kW to 7.8 kg/kW. Author

**N77-19168#** Rocket Propulsion Establishment, Westcott (England).
**A BALLISTIC TECHNIQUE FOR ACCURATE MEASUREMENT OF TOTAL IMPULSE AND THRUST OF ROCKET MOTORS WITH SHORT BURNING TIMES**
D. S. Dean Mar. 1976 18 p
(RPE-Memo-675; BR53533) Avail: NTIS HC A02/MF A01

A method is described whereby a rocket motor impulse lasting a few milliseconds may be spread over a longer period to allow it to be recorded by conventional methods with an accuracy of + or - 0.2%. Instantaneous thrust is also recorded with an accuracy of + or - 2%. Most of the problems encountered with a ballistic pendulum are avoided and only the static calibration of a load cell is required before use. Author (ESA)

# 23 CHEMISTRY AND MATERIALS (GENERAL)

Includes biochemistry and organic chemistry.

**N77-19169#** Air Force Materials Lab., Wright-Patterson AFB, Ohio. Nonmetallic Materials Div.
**ACETYLENE TERMINATED QUINOXALINES ATQ Final Technical Report, Nov. 1974 - Oct. 1975**
R. F. Kovar (Dayton Univ. Research Inst., Ohio), G. F. L. Ehlers, and F. E. Arnold Jun. 1976 35 p refs
(AF Proj. 7340)
(AD-A031003; AFML-TR-76-71) Avail: NTIS HC A03/MF A01 CSCL 11/9

A series of acetylene terminated phenylquinoxaline oligomers have been prepared which cure by addition, without the evolution of volatiles. The synthesis utilized the novel terminal acetylene end-capping reagent, 3-(3,4-diaminophenoxy)phenyl acetylene. The end-capped oligomers were soluble (20-30%) in low boiling organic solvents and exhibited a high degree of flow at their softening temperatures. Thermal analytical data obtained on the oligomers indicated initial softening in the vicinity of 160 C and a strong polymerization exotherm maximizing at 274 C. Cured samples (8 hrs at 280 C) exhibited Tg's of approximately 320 C. Mass spectrometry-thermogravimetric analysis of the polymers demonstrated that no volatiles were emitted during cure, and that decomposition of the resins initiated at 465 C.
Author (GRA)

# 24 COMPOSITE MATERIALS

Includes laminates.

**N77-19170*** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**LEADING EDGE PROTECTION FOR COMPOSITE BLADES Patent**
James W. Brantley (GE Co., Cincinnati) and Thomas P. Irwin, inventors (to NASA) (GE Co., Cincinnati) Issued 8 Feb. 1977 6 p Filed 17 Jul. 1975 Sponsored by NASA
(NASA-Case-LEW-12550-1; US-Patent-4,006,999; US-Patent-Appl-SN-596905; US-Patent-Class-416-224; US-Patent-Class-416-230) Avail: US Patent Office CSCL 11D

A laminated filament composite structure, such as an airfoil for use in an environment in which it is subjected to both foreign object impact and bending is provided with improved leading edge protection. At least one fine wire mesh layer is partially bonded within the composite structure along its neutral bending axis. A portion of the wire mesh layer extends beyond the neutral bending axis and partially around the leading edge where it is bonded to the outer periphery of the primary composite structure. The wire mesh is clad with a metal such as nickel to provide an improved leading edge protective device which is firmly anchored within the composite structure. Also described is a novel method of constructing a composite airfoil so as to further minimize the possibility of losing the leading edge protective device due to delamination caused by impact and bending.
Official Gazette of the U.S. Patent Office

DATA SUMMARY: No numeric data are presented.

**N77-19171*** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**METHOD OF MAKING REINFORCED COMPOSITE STRUCTURE Patent**
Lee C. McCandless (General Technologies Corp., Reston, Va.) and Glenn E. Weber, inventors (to NASA) (General Technologies Corp., Reston, Va.) Issued 2 Nov. 1976 6 p Filed 19 Apr. 1974 Supersedes N76-16181 (14 - 07, p 0817) Sponsored by NASA
(NASA-Case-LEW-12619-1; US-Patent-3,989,602; US-Patent-Appl-SN-462424; US-Patent-Class-204-9; US-Patent-Class-29-527.2; US-Patent-Class-204-16;

US-Patent-Class-204-40) Avail: US Patent Office CSCL 11D

High strength nickel matrix structures are achieved by using reinforcing filament windings. Metal matrix materials were electro-formed on and between the windings to form each new layer of the composite structure.

Official Gazette of the U.S. Patent Office

DATA SUMMARY: Reinforcing stainless steel wires in nickel matrices for cylindrical windings; the variables include wire thickness, layers, nickel matrix materials, tensile strength, heat treatment, electroplating, and machining; 7 figures and 3 tables.

**N77-19172#** Lockheed Missiles and Space Co., Palo Alto, Calif.

**STRENGTH CRITERION FOR ORTHOGONALLY BOUNDED COMPOSITES WITH A POLYMER MATRIX**

Il M. Makhmutov and A. N. Polilov [1976] 11 p refs Transl. into ENGLISH from Izv. AN SSSR, Mekhan, Tverd. Tela (USSR), v. 5, 1976 p 160-169

Avail: NTIS HC A02/MF A01; National Translation Center, John Crerar Library, Chicago, Illinois 60616

A strength criterion is proposed for composites under tension, which consists of reaching the critical value of some combination of stresses in a plane related to the direction of the fibers. By using this criterion, a dependence of the strength on the loading direction is described and the problem of stress concentration taking account of pre-fracture, which diminishes the effective depth of the stress concentrator, is solved. It is shown that the presence of holes or necks in a composite stretched at an angle to the bonding direction does not reduce the strength of the material. Author

DATA SUMMARY: Strength of composite plates with circular holes, semicircular necks, or angular necks; variables include strength, radius; 1 table includes numeric data.

**N77-19173*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

**LOW DENSITY BISMALEIMIDE-CARBON MICROBALLOON COMPOSITES Patent Application**

Demetrius A. Kourtides and John A. Parker, inventors (to NASA) Filed 16 Mar. 1977 25 p

(NASA-Case-ARC-11040-1; US-Patent-Appl-SN-778195) Avail: NTIS HC A02/MF A01 CSCL 11D

Composite laminate structures of glass cloth are reported that are preimpregnated with polybismaleimide resin and adhered to a polybismaleimide glass or aromatic polyamide paper honeycomb cell structure filled, or partially filled, with a syntactic foam consisting of a mixture of bismaleimide resin and carbon microballoons. The carbon microballoons are prepared by pyrolyzing phenolic microballoons and subsequently bonded by using a 2% bismaleimide solution. The laminate structures are cured for two hours at 477 K and are adhered to the honeycomb bismaleimide adhesive using a pressure of 700kN/ sq m pressure at 450 K. The laminate composite is then post-cured for two hours at 527 K to produce a composite laminate having a density in the range from about 95 kilograms per cubic meter to 130 kilograms per cubic meter. NASA

DATA SUMMARY: Heat and flame resistant composite laminate honeycomb structures using resin impregnated fiberglass bonding to porous core: the variables include polymerized bismaleimide resins, composite components, weight, temperature effect, thermal conductivity, volatile products and toxicity, smoke evolution, and mechanical properties; no figures and 8 tables.

**N77-19174#** California Univ., Livermore. Lawrence Livermore Lab.

**APPLICATION OF YERZLEY MECHANICAL OSCILLOGRAPH TO TESTING OF Y3333 CELLULAR SILICONE Progress Report**

W. E. Cady and L. E. Caley 12 Mar. 1976 15 p refs

(Contract W-7405-eng-48)

(UCID-17080; PR-1) Avail: NTIS HC A02/MF A01

The density, thickness, resilience, and effective dynamic modulus of Y3333 cellular silicone were measured. Test samples came from five lots of standard Y3333 compound and from two lots of experimental Y3333. Tests of the four properties revealed that individual sheets of Y3333 were homogeneous. Since sheets from the same lot differed little in properties, normal process variations had minimal effect on properties. Although lot-to-lot variation of standard Y3333 was statistically significant, the coefficients of variation of 5 percent or less indicated a reasonable consistency among the five lots tested. The two experimental lots of Y3333, made with known material and manufacturing variables, showed a response to the variations but maintained low coefficients of variation. After evaluating the Yerzley instrument, it was decided that it demonstrated its worth for detecting differences among Y3333 cellular silicones. ERA

DATA SUMMARY: Tests were conducted to determine certain properties of Y3333 silicone and statistical analyses were performed on the results; variables include resilience, effective dynamic modulus, thickness, density, standard deviation, coefficient of variation, spread; 5 tables include numeric data.

**N77-19175#** Argonne National Lab., Ill.

**CYCLIC STRESS EFFECTS ON TRANSPORT PROPERTIES OF SUPERCONDUCTING COMPOSITE MATERIALS**

E. S. Fisher and S. H. Kim 1976 26 p refs Presented at the 6th ICED meeting, Grenoble, France, 11 May 1976

(Contract W-31-109-eng-38)

(CONF-760508-4) Avail: NTIS HC A03/MF A01

The effects of cyclic stresses at 4.2 K on the conductor materials for large superconducting magnets are being investigated in samples of unalloyed copper and of composites containing Nb-Ti or Nb3Sn wires in a copper matrix. The samples are constant strain cycled in pure tension-compression modes. The increase in electrical resistivity of different grades of copper with number and amplitude of cycles is described. The increases can be of the order of the magnetoresistance for 1000 to 2000 cycles at 0.20 percent strain per cycle. The facility for measuring critical current changes with composite cycling is described and the initial results indicate significant I/sub c/changes as well as unexpected filament fractures. Author (ERA)

DATA SUMMARY: Deformation and magnetoresistivity of superconducting metal filaments in copper matrix; the variables include copper sample composition, heat treatment, temperature effects, cyclic strain parameters, stress-strain-time relations, number of cycles, and magnetoresistivity; 6 figures and 3 tables.

**N77-19176#** California Univ., Livermore. Lawrence Livermore Lab.

**STOCHASTIC THREE-DIMENSIONAL FINITE ELEMENT FOR PARALLEL FIBER COMPOSITES**

Richard A. Larder and C. W. Beadle 16 Apr. 1976 7 p refs Presented at the Conf. on Computer Simulation for Mater. Appl., Gaithersburg, Md., 14 Apr. 1976

(UCRL-78091; Conf-760421-6) Avail: NTIS HC A02/MF A01

The design of realistic structures using fiber composites is difficult because of the statistical variations in the properties of the constituents. Practical designs still rely heavily on empirical evaluation of material combinations. The development of a nonlinear, three dimensional, stochastic finite element for the structural analysis of parallel fiber composites is described. This element is incorporated into an existing 3-d finite element program. The stochastic properties of the finite elements are described by a damage function which varies in a random fashion throughout the structure. The damage function in turn is determined from a direct simulation of microscopic failure in parallel fiber composites. This direct simulation procedure would in general be too costly to utilize for realistically sized structures but does provide the information for determining the damage function as well as the opportunity for observing the failure process in detail. ERA

DATA SUMMARY: Stress strain curves for macrosimulation; variables include stress, strain, additional force to failure, additional deflection at failure, deflection force, and force in pounds; 5 figures include numeric data.

**N77-19177#** California Univ., Livermore. Lawrence Livermore Lab.

**FIBER COMPOSITES: A REVIEW AND ASSESSMENT**

E. M. Wu and T. T. Chiao 28 Apr. 1976 7 p Presented at the Meeting of the Am. Inst. of Chem. Eng., Atlantic City, 27 Aug. 1976
(Contract W-7405-eng-48)
(UCRL-78146; Conf-760823-1) Avail: NTIS HC A02/MF A01

Questions of performance, reliability, economics, and energy utilization as they relate to composites are examined in an effort to arrive at an assessment of the prospects for composites in relationship to other materials. ERA

DATA SUMMARY: Specific structural properties and fatigue resistance for composites; variables include strength, modulus, failure stress, cycles to failure, fracture toughness, thickness, dollars/pounds, and thermal expansion; 4 figures and 2 tables include numeric data.

**N77-19178#** General Atomic Co., San Diego, Calif.
**STRUCTURE OF CHEMICAL VAPOR DEPOSITED SILICON CARBIDE**
J. Chin, P. K. Gantzel, and R. G. Hudson 15 Mar. 1976 32 p refs Presented at the Am. Vacuum Soc. Conf., San Francisco, 5-9 Apr. 1976 Submitted for publication
(Contract E(04-3)-167)
(GA-A-13845; Conf-760454-1) Avail: NTIS HC A03/MF A01

The morphologies of SiC deposited by the thermal decomposition of CH3SiCl3 are presented. These are non fluid bed deposits prepared in an induction heated reactor. The morphologies of the deposits were found to vary systematically with the substrate temperature, chamber pressure, and gas composition. Low temperature, moderate chamber pressure, low H2/CH3SiCl3 ratio deposits were generally fine grained. Macrograins composed of finer micrograins are typical in intermediate temperature deposits. Surface contours of the macrograins were smoothly rounded. As temperatures or pressures are increased, edges of grains become sharper, surfaces become flatter, and faceting becomes common. At very high temperatures and high H2/CH3SiCl3 ratios, large single crystals are observed. Fracture surfaces containing faceted crystals no longer show the preponderance of transgranular fracture noted in lower temperature, lower H2/CH3SiCl3 ratio deposits. ERA

DATA SUMMARY: Experimental variables, crystal structure, and chemical composition of CVD SiC; variables include substrate temperature, deposition chamber pressure, hydrogen flow, volume ratio, deposition rate, relative X ray powder intensities, plane of preferred orientation, weight percent; 4 tables include numeric data.

**N77-19179#** California Univ., La Jolla. Dept. of Applied Mechanics and Engineering Sciences.
**MECHANICS OF COMPOSITE MATERIALS Final Report, 1 Jul. 1970 - 30 Jun. 1976**
G. A. Hegemier 1976 39 p refs
(Grant AF-AFOSR-2870-75; AF Proj. 9782)
(AD-A029674; AFOSR-76-1069TR) Avail: NTIS HC A03/MF A01 CSCL 11/4

The report summarizes the results of a theoretical study of wave propagation, diffusion, and damage accumulation in composite materials. GRA

DATA SUMMARY: Wave propagation, stress behavior, and temperature distribution in fiber reinforced phenolic resins were analyzed; variables include averaged velocity, time, normalized rear surface velocity, axial stress, input stress, radius, average stress, particle velocity, temperature; 14 figures include numeric data.

# 25 INORGANIC AND PHYSICAL CHEMISTRY

Includes chemical analysis, e.g., chromatography; combustion theory; electrochemistry; and photochemistry.

For related information see also *77 Thermodynamics and Statistical Physics*.

**N77-19180*#** Scientific Translation Service, Santa Barbara, Calif.
**THEORETICAL DISTRIBUTION OF HYDROGEN ISOTOPES IN THE SYSTEM H2-HC1-OH-HCN-H20-H2S-NH3-CH4**
Pascal Richet and Yan Bottinga Washington NASA Mar. 1977 9 p refs Transl. into ENGLISH from Comptes Rendus (Paris), v. 283, ser. D, 13 Sep. 1976 p 299-302
(Contract NASw-2791)
(NASA-TT-F-17366) Avail: NTIS HC A02/MF A01 CSCL 07D

Equilibrium deuterium fractionation among gaseous molecules of geochemical interest was calculated for the temperature interval 200 to 1300 C. The calculated results agree well with the few available experimentally determined equilibrium constants. Some geochemical applications are discussed. Author

**N77-19181*#** Scientific Translation Service, Santa Barbara, Calif.
**THE EFFECT OF THE CHEMICAL COMPOSITION OF ISOPARAFFIN OIL ON ITS THERMAL-OXIDATIVE STABILITY**
A. F. Khurumova, T. M. Komissarova, A. I. Dintses, K. I. Zimina, A. A. Polyakova, and A. G. Siryuk Washington NASA Mar. 1977 8 p Transl. into ENGLISH from Neftepererab. i Neftekhim. (USSR), no. 11, 1973 p 15-18
(Contract NASw-2791)
(NASA-TT-F-17413) Avail: NTIS HC A02/MF A01 CSCL 07D

An isoparaffinic oil was obtained as a deparaffinated hydroisomerizated fraction from petrolatum and consisted of saturated hydrocarbons 85, and arom. hydrocarbons 15 wt. %. The oil added with 0.5% Ionol was stable to 50 hr oxidation at 175 deg. The antioxidation activity of Ionol depended on the hydrocarbon composition of the oil. Author

**N77-19182#** Lockheed Missiles and Space Co., Palo Alto, Calif.
**ELECTROCHEMICAL BEHAVIOR OF LITHIUM ON A MERCURY ELECTRODE**
V. P. Gladyshev, L. M. Ruban, and V. A. Kuleshov [1977] 8 p refs Transl. into ENGLISH from Tr., Inst. Khim. Nauk AN KazSSR (USSR), v. 24, 1969 p 111-119
Avail: NTIS HC A02/MF A01; National Translation Center, John Crerar Library, Chicago, Illinois 60616

Amalgam electrodes were proposed for utilization in the technology and preparative practice of obtaining a number of lithium compounds. The mercury method of obtaining lithium hydroxide is used extensively. The possibility of obtaining lithium hydroxide by the electrolysis of solutions of lithium chloride with a mercury cathode and subsequent decomposition of the amalgam was studied. The rate of amalgam interaction with the solution diminishes with the rise in electrolyte concentration. The current yield is about 97 percent at a 25 to 30 deg temperature with a 30 to 35 percent content of lithium chloride in the electrolyte and a 1,700 to 2,500 A/sq m cathode current density. Author

**N77-19183*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**THE FLUORINATION OF COBALT AND ZINC**
Patricia Marie ODonnell Jul. 1976 112 p refs
(NASA-TM-X-73478; E-8233) Avail: NTIS HC A06/MF A01 CSCL 07D

The reaction of cobalt and zinc with gaseous fluorine was studied. Both temperature and pressure were variables, ranging from 298 to 773 K and 50 to 625 torr. Both reactions were described by the parabolic rate law. The reaction was both temperature and pressure dependent. In the zinc reaction the vaporization rate of zinc above 573 K complicated the kinetics. The cobalt reaction was complex due to the formation of two fluorides. Parabolic rate constants have been calculated and from the temperature dependence of the reaction a heat of reaction

of 2.8 kcal-mole sec for zinc and 4.8 kcal-mole sec for cobalt in the low temperature range has been estimated. A theoretical analysis indicated the most probable mechanism for both reactions is cation diffusion through cation vacancies. Comparisons with reported oxidation kinetics are given. Author

**N77-19184*#** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
**TABLE AND CHARTS OF EQUILIBRIUM NORMAL-SHOCK PROPERTIES FOR PURE HYDROGEN WITH VELOCITIES TO 70 km/sec**
Charles G. Miller, III and Sue E. Wilder Washington 1976 230 p refs
(NASA-SP-3087) Avail: NTIS HC A11/MF A01 CSCL 07D

Errors found in the original edition are corrected. Refinement was made in procedures for solving the conservation relations for an incident (moving), standing, and reflected normal shock, as well as in computational methods for determining thermochemical-equilibrium hydrogen properties. A six-species hydrogen model replaces the original four-species model, and the heat of formation and spectroscopic constants used in this six-species model are listed in appendix A. In appendix B, comparisons are made between a number of methods for determining equilibrium thermodynamic properties for hydrogen for several values of pressure and temperatures to 50000 K. A comparison is also performed between the present method and a second method for determining thermodynamic properties and flow velocity behind an incident shock into pure hydrogen and behind a reflected shock. Author

**N77-19185#** California Univ., Livermore. Lawrence Livermore Lab.
**IGNITION INHIBITORS FOR CELLULOSIC MATERIALS**
N. J. Alvares 5 Apr. 1976 7 p refs Presented at 172nd Am. Chem. Soc. Meeting, San Francisco, 29 Aug. - 3 Sep. 1976
(Contract W-7405-eng-48)
(UCRL-78026; Conf-760826-4) Avail: NTIS HC A02/MF A01

By exposing samples to various irradiance levels from a calibrated thermal radiation source, the ignition responses of blackened alpha-cellulose and cotton cloth with and without fire-retardant additives were compared. Samples treated with retardant compounds which showed the most promise were then isothermally pyrolyzed in air for comparisons between the pyrolysis rates. Gamma radiation results in ignition retardance of cellulose, while irradiation by neutrons does not. ERA

**N77-19186#** Massachusetts Inst. of Tech., Oak Ridge, Tenn. School of Chemical Engineering Practice.
**ELUTION ELECTROPHORESIS AS A CLINICAL TOOL**
G. R. Wilkes, R. J. Bertolami, W. M. Choi, and P. D. Terpandjian 24 Mar. 1976 47 p refs Sponsored by ERDA
(ORNL/MIT-230) Avail: NTIS HC A03/MF A01

An experimental investigation of an elution electrophoresis system with a particulate gel packed column was performed. The operating parameters of the apparatus were determined with elution flow studies and electrophoresis migration studies. Flow study results indicated that sample dispersion is dependent on packing type, packing size, elution flow rate, and outlet geometry. Migration studies revealed that sample migration is dependent upon the packing type, packing size, buffer solution, and applied voltage. Minimum criteria for feasibility were an established difference in migration rates for different pure samples and maintenance of the separation during elution. ERA

**N77-19187#** Brookhaven National Lab., Upton, N.Y. Dept. of Chemistry.
**NEUTRON DIFFRACTION STUDIES OF TRANSITION METAL HYDRIDE COMPLEXES**
Thomas F. Koetzle and Robert Bau (Univ. of Southern Calif., Los Angeles) 1976 10 p refs Presented at Conf. on Neutron Scattering, Gatlinburg, Tenn., 6 Jun. 1975 Sponsored in part by NSF and the Petroleum Research Fund
(Contract E(30-1)-16)
(BNL-21470; Conf-760601-6) Avail: NTIS HC A02/MF A01

Results of an investigation on metal hydride complexes are presented. General observations on the geometry and the nature of bonding in these compounds are made. B.B.

**N77-19188#** Argonne National Lab., Ill.
**SOLUTION BEHAVIOR OF HYDROGEN ISOTOPES AND OTHER NON-METALLIC ELEMENTS IN LIQUID LITHIUM**
V. A. Maroni, W. F. Calaway, E. Veleckis, and R. M. Yonco 1976 10 p refs Presented at the Intern. Conf. on Liquified Metal Technology in Energy Production, Champion, Pa., 3 May 1976
(Contract W-31-109-eng-38)
(CONF-760503-5) Avail: NTIS HC A02/MF A01

Selected thermodynamic properties for systems of lithium with non-metallic elements are reported. Investigations of the Li-H, and Li-T systems have led to the elucidation of the dilute solution behavior and H/D/T isotope effects. In the case of the Li-H and Li-D systems, the principal features of the respective phase diagrams were delineated. The solubility of Li-D in liquid lithium was measured down to 200 C. The solubility of $Li_3N$ in liquid lithium and the thermal decomposition of $Li_3N$ were studied. From these data, the free energy of formation of $Li_3N$ and the Sieverts' constant for dissolution of nitrogen in lithium were determined. ERA

**N77-19189#** Sandia Labs., Albuquerque, N.Mex. Applied Physics Div.
**HELIUM RELEASE FROM METAL TRITIDES**
William J. Kass Jul. 1976 23 p refs
(Contract AT(29-1)-789)
(SAND-76-0339) Avail: NTIS HC A02/MF A01

Comparisons of the erbium tritide powder samples indicates a strong dependence of 3He release on the original tritium stoichiometry. Since all the samples are of the same structure in this stoichiometry range, the subsequent filling of more and more octahedral interstices in the erbium lattice by tritium contributes to the differences in release rates. The release data for the scandium tritium solid solution samples is governed by the difference in grain sizes among the samples. This conclusion is consistent with a release model in which the release rate is strictly dependent on the amount of 3He near a grain boundary. The comparison of the data from the Er, Zr, Ti, and Sc films indicates that accelerated release occurs at different 3He/M ratios. ERA

**N77-19190#** Brookhaven National Lab., Upton, N.Y.
**LATTICE DYNAMICS OF NEON AT HIGH PRESSURE**
J. Eckert, J. D. Axe, and W. B. Daniels (Delaware Univ., Newark) 1976 5 p refs Presented at Conf. on Neutron Scattering, Gatlinburg, Tenn., 6 Jun. 1976 Sponsored in part by NSF
(Contract E(30-1)-16)
(BNL-21390; Conf-760601-9) Avail: NTIS HC A02/MF A01

The phonon dispersion relations in a high-density Ne crystal were measured in the (110), (110), and (111) symmetry directions at 8K using a triple-axis neutron spectrometer. The crystal was grown at a pressure of 6 kbar and at 82K in a new high pressure sample holder. A Born-Von Karman force constant analysis indicated that the interatomic forces in Ne remain predominantly central in nature at this density. A newly analyzed combination of three previous neutron scattering studies of phonon dispersion relations in Ne crystals of approximately equilibrium density was used in conjunction with the present results to derive a dispersion of quasiharmonic mode Grueneisen parameters. These were approximately summed to obtain the macroscopic Grueneisen parameter. ERA

**N77-19191#** California Univ., Livermore. Lawrence Livermore Lab. Dept. of Electronics Engineering.
**FAST RABBIT AND RAPID CHEMISTRY: A CONTROL SYSTEM FOR AUTOMATED CHEMICAL ANALYSIS**
S. C. Bourret 30 Jun. 1976 14 p
(Contract W-7405-eng-48)
(UCID-17181) Avail: NTIS HC A02/MF A01

The complete microcomputer controlled system which consists of two interrelated subsystems is described. The first is the fast rabbit system for moving the sample in and out of the reactor at specified times and the second is the receiving station for the rapid automated chemical program for the irradiated sample

and its disposal. The system allows operator interaction.
Author (ERA)

**N77-19192#** Sandia Labs., Albuquerque, N.Mex.
**INTERPRETATION OF THE SPECTRAL STRUCTURE OF RAYLEIGH SCATTERED LIGHT FROM COMBUSTION GASES**
Robert Cattolica, F. Robben (Calif. Univ. Berkeley. Lawrence Berkeley Lab.), and L. Talbot (Calif. Univ., Berkeley) Dec. 1975 25 p refs Presented at AIAA Aerospace Sci. Meeting, Washington, D. C., 26 Jan. 1976
(Contract AT(29-1)-789)
(SAND-75-8704; Conf-760102-5) Avail: NTIS HC A02/MF A01

The determination of the temperature of combustion gases from Rayleigh scattered laser light can be greatly simplified if the effect of Brillouin scattering is assumed to be negligible. To define precisely the regimes in which this assumption is applicable, measurements of the broadening effect of Brillouin scattering on the Rayleigh spectra from nitrogen, oxygen, air and argon were made with a Fabry-Perot spectrometer. These spectra were analyzed using a trimodal Gaussian model convoluted with the instrument function for the spectrometer. The results of this investigation indicate that if the value of a parameter is y, the ratio of the wavelength of the fluctuations producing the scattering divided by 2 pi to the collision mean free path, is less than 0.1, Brillouin scattering is negligible. This criterion is shown to be satisfied in the post flame zone of an atmospheric pressure premixed hydrogen air flame. ERA

**N77-19193#** California Univ., Berkeley. Lawrence Berkeley Lab.
**CHEMICAL APPLICATIONS OF X-RAY PHOTOELECTRON SPECTROSCOPY**
B. E. Mills May 1976 122 p refs
(Contract W-7405-eng-48)
(LBL-5123) Avail: NTIS HC A06/MF A01

X-ray photoelectron spectroscopy was used to study the effect of chemical environment and molecular structure on the electronic levels of various free molecules and elemental solids. Core level binding energies were measured and compared with first ionization potentials in a series of alkyl iodides in order to understand the effect of changes in substituent on the electron density around the iodine nucleus. Core level binding-energy shifts were measured for oxygen ls levels in alcohols, ethers, aldehydes, acids, esters, and acetone; nitrogen ls levels in ammonia and aliphatic amines; phosphorus 2p levels in phosphine and its methyl derivatives; and sulfur 2p levels in H2S and its methyl derivatives. ERA

**N77-19194#** California Univ., Livermore. Lawrence Livermore Lab.
**HYDROGEN-DEUTERIUM EXCHANGE IN WATER VAPOR: THE MASS SPECTROMETRIC SENSITIVITIES AND THE EQUILIBRIUM CONSTANT**
J. W. Pyper, R. J. Dupzyk, R. D. Friesen, S. L. Bernasek (Princeton Univ., N. J.), C. A. May, A. W. Echeverria, and L. F. Tolman 21 Apr. 1976 34 p refs Presented at the Conf. on Mass Spectrometry and Allied Topics, San Diego, Calif., 9-14 May 1976 Submitted for publication
(UCRL-77583; Conf-760524-1) Avail: NTIS HC A03/MF A01

The equilibrium constant, K/sub HDO/, for the reaction H2O + D2O = 2HDO is expressed as an intensity ratio, I measured mass spectrometrically, times a sensitivity ratio, S, measured in mass spectrometric calibration experiments. An indirect measurement of S using a pulsed-molecular beam quadrupole mass filter that has a unique three-chamber, three-leak gas inlet system is reported. The results show the sensitivities are probably equal and therefore S = 1. Systematic errors were found in the procedure, however, which precluded an unambiguous test of the theory. ERA

**N77-19195#** Atomics International, Golden, Colo.
**DETERMINATION OF BERYLLIUM IN URINE, HAIR, FINGERNAIL, AND FECAL SAMPLES BY FLAMELESS ATOMIC ABSORPTION SPECTROMETRY**
7 May 1976 9 p refs
(Contract E(29-2)-3533)
(RFP-2443) Avail: NTIS HC A02/MF A01

Methods for determining trace amounts of beryllium in urine, hair, fingernail, and fecal samples are described. These methods involve use of a spectrophotometer equipped with graphite furnace. Lanthanum was used as a masking and enhancing agent, and recoveries were determined by direct comparison with aqueous standards. The hair and fingernail samples were degraded readily in a nitric acid perchloric acid mixture, and the feces were digested rapidly using a ferrous ion, hydrogen peroxide method. The urine samples were run by two methods: (1) direct and (2) coprecipitation. Nanogram-per-gram levels of beryllium were recovered from all tissues and fluids. All recoveries varied from 90 to 110 percent with relative standard deviations of less than 13 percent. ERA

**N77-19196#** Atomics International, Golden, Colo.
**FLAMELESS ATOMIC ABSORTION DETERMINATION OF BERYLLIUM IN THE PRESENCE OF VARIOUS ANIONS AND CATIONS**
Jeffrey A. Hurlbut and Dale L. Bokowski May 1976 11 p refs
(Contract E(29-2)-3533)
(RFP-2442) Avail: NTIS HC A02/MF A01

A method for determining trace amounts of beryllium in the presence of various anions and cations is described. The method involves use of a spectrophotometer equipped with graphite furnace. The absorption signal from 20 ng/ml of beryllium varies significantly from acid to acid, and both 5 percent (V/V) nitric acid and 5 percent (V/V) sulfuric acid were studied as possible analysis solvents. Absorption signal enhancement and suppression caused by the presence of other chemicals appears similar in either solvent. Concentrations of more than 0.1M hydrochloric and hydrofluoric acid suppress the signal in both solvents. ERA

**N77-19197#** Argonne National Lab., Ill. Chemistry Div.
**MEASUREMENT OF THE HYDROGEN YIELD IN THE RADIOLYSIS OF WATER BY DISSOLVED FISSION PRODUCTS**
M. C. Sauer, Jr., E. J. Hart, K. E. Flynn, and J. E. Gindler Apr. 1976 16 p refs
(Contract W-31-109-eng-38)
(ANL-76-46) Avail: NTIS HC A02/MF A01

Hydrogen from the radiolysis of water by dissolved fission products is stripped from the solution and collected by bubbling CO2 through the solution. Quantitative measurements of the G value for hydrogen show that the yield is essentially the same as would be obtained by external gamma radiolysis of nonradioactive solutions of the same chemical composition. The hydrogen yield is enhanced by addition of a hydrogen-atom donor, such as formic acid, to the solution. The yield of hydrogen from fission-waste solutions is discussed with respect to the question of whether it represents a significant energy source. ERA

**N77-19198#** Brookhaven National Lab., Upton, N.Y.
**SOLID ELECTROLYTE AND ELEVATED TEMPERATURE WATER ELECTROLYSIS**
S. Srinivasan and F. J. Salzano 1976 20 p refs Presented at AIM Meeting, Liege, 15 Nov. 1976
(Contract E(30-1)-16)
(BNL-21547; Conf-761102-1) Avail: NTIS HC A01/MF A02

The proposed plans are to build a 0.5-Mw demonstration system by 1979 and a 5-Mw prototype unit by the mid-1980's. The 1980 performance goal is for a cell to operate at a current density of 1 amp/sq cm with a voltage input of 1.58 volts. Capital costs of less than $100/kw are projected. The development of solid oxide water electrolysis cells, operating at temperatures of about 1000 C will take a considerably longer time. Though the electrical energy requirements of this cell are expected to be lower than cells operating at 150 C by more than 30 percent, an external heat source is necessary to maintain the cell temperature during the endothermic reaction. ERA

**N77-19199#** Los Alamos Scientific Lab., N.Mex.
**ANALYSIS OF CARBON MONOXIDE PRODUCTION IN MULTIHUNDRED-WATT HEAT SOURCES**
D. E. Peterson May 1976 15 p refs
(Contract W-7405-eng-36)

(LA-6376-MS) Avail: NTIS HC A02/MF A01

The production of carbon monoxide observed within Multihundred Watt heat sources placed under storage conditions was analyzed. Results of compositional and isotopic analyses of gas taps performed on eight heat sources are summarized and interpreted. Several proposed CO generation mechanisms are examined theoretically and assessed by applying thermodynamic principles. Outgassing of the heat source graphite followed by oxygen isotopic exchange through the vent assemblies appears to explain the CO production at storage temperatures. Reduction of the plutonia fuel sphere by the CO is examined as a function of temperature and stoichiometry. Experiments that could be performed to investigate possible CO generation mechanisms are discussed. ERA

**N77-19200#** California Univ., Berkeley. Lawrence Berkeley Lab.

**ARCHAEOLOGIST LOOKS AT X-RAY FLUORESCENCE VS. NEUTRON ACTIVATION ANALYSIS**

Michal Artzy Apr. 1976 16 p refs Presented at Appl. of Sci. to Medieval Ceram. Conf., Berkeley, Calif., 18 Mar. 1976

(Contract W-7405-eng-48)

(LBL-5017; Conf-760353-1) Avail: NTIS HC A02/MF A01

Neutron activation analysis (NAA) and X-ray fluorescence (XRE) are compared; a periodic table of the elements showing their sensitivity to each method is included. It is proposed to use both methods to make chemical abundances measurements on a archaeological samples, including Bichrome Ware and Palestinian samples. The intent is to see if NAA can be replaced by XRE. ERA

**N77-19201#** Mound Lab., Miamisburg, Ohio.

**CHROMATOGRAPHIC MEASUREMENT OF HYDROGEN ISOTOPIC AND PERMANENT GAS IMPURITIES IN TRITIUM**

David K. Warner, C. Kinard, and D. C. Bohl 4 Jun. 1976 30 p refs

(Contract E(33-1)-GEN-53)

(MLM-2308) Avail: NTIS HC A03/MF A01

A gas chromatograph is described for dedicated analysis of hydrogen isotopic and permanent gas impurities in tritium and tritium-deuterium mixtures. The instrument improves the accuracy and precision of hydrogen isotopic analysis in the 20 ppM to one mole percent range as compared with other analytical methods. Several unique design features of the instrument were required due to the radiation and isotopic exchange properties of the tritium in the samples; descriptions of these features are presented along with details of the complete chromatographic system. The experimental procedures used to calibrate the detector and statistically evaluate its performance are given, and the sources of analytical error are cited. The limitations of the present system are also discussed. ERA

**N77-19202#** California Univ., Santa Barbara. Dept. of Physics and Quantum Mechanics.

**PHOTOLUMINESCENCE SPECTROSCOPY OF DIATOMIC MOLECULES Final Report, 1 Jun. 1974 - 31 May 1976**

Herbert P. Broida 22 Jul. 1976 60 p refs

(Contracts N00014-69-A-0200-8013; N00014-75-C-0829)

(AD-A031109) Avail: NTIS HC A04/MF A01 CSCL 07/4

Optical spectroscopy has been used to study laser spectrochemistry of Bi2 molecules. Molecular constants and new electronic states of Bi2, energy exchange between Bi2 and foreign gases, lifetimes of excited states, and chemical reactions between bismuth vapor and several oxidants have been measured. Two different types of apparatus, a flow furnace system and a heat pipe system were used for bismuth sources. Special attention has been given to reactions of bismuth with various oxidants in heat-pipe reactors. Preliminary surveys of reactions of aluminum and calcium with hydrogen containing molecules were made. A 'photon correlator' which is a delayed coincidence device, has been constructed to measure lifetimes and time resolved spectra of a very weak signal. Capabilities of this device were successfully demonstrated by measurements of lifetimes of I2 in single rotational transitions. Some interesting new results were obtained in the laser photoluminescence of Ca2 in the heat-pipe.

Author (GRA)

**N77-19203#** Colorado State Univ., Fort Collins. Dept. of Chemistry.

**ORGANIC ELECTROCHEMISTRY IN ALUMINUM CHLORIDE MELTS Final Report, 1 Oct. 1972 - 30 May 1976**

R. A. Osteryoung and L. L. Miller 15 Aug. 1976 10 p refs

(Grant DA-ARO(D)-31-124-73-G18)

(AD-A031082) Avail: NTIS HC A02/MF A01 CSCL 07/4

Organic electrochemistry and chemical studies have been carried out in molten sodium tetrachloroaluminate at 175 C and in an ethylpyridinium bromide-aluminum chloride melt, with benzene as a cosolvent at room temperature. The reductive defunctionalization of a number of adamantanes was studied in the sodium tetrachloroaluminate system at 175 C. In the room temperature melt, with benzene, the oxidation of hexamethylbenzene was studied and was found to yield pentamethylbenzene and diphenylmethane. The pentamethylbenzene could be further oxidized to tetramethylbenzene and diphenylmethane. A mechanism is proposed. Several iron diimine complexes were also studied in this melt. GRA

**N77-19204#** Colorado State Univ., Fort Collins. Dept. of Chemistry.

**ELECTROCHEMICAL STUDIES IN ALUMINUM CHLORIDE MELTS Final Report, 1 Mar. 1975 - 31 May 1976**

Robert A. Osteryoung Jul. 1976 14 p refs

(Grant AF-AFOSR-2776-75; AF Proj. 9536)

(AD-A030911; AFOSR-76-1109TR) Avail: NTIS HC A02/MF A01 CSCL 07/4

The acid-dependent chemistry of sulfur was investigated. The behavior of oxides, selenides and tellurides were compared with sulfides. A detailed electrochemical study of selenium was undertaken. The electrochemistry of various molybdenum species was also studied. GRA

**N77-19205#** United Technologies Research Center, East Hartford, Conn.

**ELECTROCHEMISTRY OF HYDRAZINE-HYDRAZINE AZIDE MIXTURES Final Scientific Report, 1 Mar. 1972 - 30 Jun. 1976**

Charles T. Brown Sep. 1976 92 p refs

(Contract F44620-72-C-0049; AF Proj. 9536)

(AD-A031196; UTRC/R76-911319; AFOSR-76-1118TR) Avail: NTIS HC A05/MF A01 CSCL 07/4

This document constitutes the final report under Contract F44620-72-C-0049, 'Electrochemistry of Hydrazine-Hydrazine Azide Mixtures'. Investigations into the nature of hydrazine and hydrazine derivatives were carried out with the objective of providing solvents for electrochemical applications which exhibit large potential ranges without sacrificing solubility levels of the reactants. The activity of the azide ion was also examined since its theoretical cell potential is high. The experimental investigations included the development of methods for the purification of hydrazine and the determination of the basic electrochemical properties of hydrazine. The effect of impurities on the conductivity of hydrazine was also determined as a function of water and carbon dioxide content. Electrode polarization measurements on platinum in the presence of hydrazine indicates that the azide ion is not electrochemically active and the electrode processes are due to the solvent itself. The basic cathodic reaction is the reduction of the hydrazonium ion to hydrogen and the anodic reaction is the oxidation of hydrazine to the hydrazonium ion and nitrogen. Studies in monomethylhydrazine and unsymmetrical dimethyhydrazine indicated an improved anodic overpotential (no nitrogen formation); however the cathodic reaction was identical to hydrazine. The program direction was changed to the study of metal-metal ion couples in hydrazine and it was found that the magnesium-magnesium ion couple was reversible and that magnesium and aluminum metals exhibit a high overpotential for solvent decomposition. GRA

**N77-19206*#** National Bureau of Standards, Washington, D.C. Inst. for Basic Standards.

**OVERVIEWS AND JUSTIFICATIONS FOR LOW GRAVITY EXPERIMENTS ON PHASE TRANSITION AND CRITICAL PHENOMENA IN FLUIDS Interim Report**

M. R. Moldover, R. J. Hocken, R. W. Gammon (Md. Univ., College Park), and J. V. Sengers (Md. Univ., College Park) Oct. 1976 105 p refs

(NASA Order C-62861-C)
(NASA-CR-149884; PB-258944/8; NBS-TN-925) Avail: NTIS HC A06/MF A01 CSCL 07D

Questions about thermodynamic properties, transport properties, and the complex nonlinear phenomena which occur when fluids undergo phase transitions in the critical region are considered. The limitations to answering these questions by experiments in the earth's gravitational field are discussed. The distinction is made between practical limits which may be extended by advances in technology and intrinsic ones which arise from the modification of fluid properties by the earth's gravitational field. The kinds of experiments near critical points which could best exploit the low gravity environment of an orbiting laboratory are identified. These include studies of the index of refraction, constant volume, specific heat, and phase separation. GRA

**N77-19122*#** National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
**COLUMN ELECTROPHORESIS ON THE APOLLO-SOYUZ TEST PROJECT. EXPERIMENT MA-011**
R. E. Allen, P. H. Rhodes, Milan Bier (VA Hospital, Tucson, Ariz.), Fortunato J. Micale (Lehigh Univ., Bethlehem, Pa.), John W. Vanderhoff (Lehigh Univ., Bethlehem, Pa.), Carel J. VanOss (State University of New York at Buffalo), P. E. Bigazzi (Conn. Univ. Health Center, Farmington), G. H. Barlow (Abbott Labs., North Chicago, Ill.), G. V. F. Seaman (Oreg. Univ. Health Scis. Center, Portland), and R. J. Knox (Oreg. Univ. Health Scis. Center, Portland) *In its* Apollo-Soyuz Test Project Jan. 1977 68 p refs (For primary document see N77-19121 10-12)
Avail: NTIS HC A20/MF A01 CSCL 07D

**N77-19123*#** Max-Planck-Institut fuer Biochemie, Martinsried bei Muenchen (West Germany).
**ELECTROPHORESIS EXPERIMENT. EXPERIMENT MA-014**
K. H. Hannig *In* NASA. Marshall Space Flight Center Apollo-Soyuz Test Project Jan. 1977 38 p ref (For primary document see N77-19121 10-12)
Avail: NTIS HC A20/MF A01 CSCL 07D

# 26 METALLIC MATERIALS

Includes physical, chemical, and mechanical properties of metals, e.g., corrosion; and metallurgy.

**N77-19207#** Israeli Program for Scientific Translations Ltd., Jerusalem.
**THEORY OF METAL CORROSION**
V. V. Skorchelletti 1976 243 p refs Transl. into ENGLISH of the book "Teoreticheskie Osnovy Korrozii Metallov", Leningrad, Izdatel'stvo Khimiya, 1973 Sponsored by the U.S.-Israel Binatl. Science Foundation
(TT-75-50013; ISBN-0-7065-1564-1) Avail: NTIS HC A11/MF A01

An overview of the theory of corrosion is presented. Topics covered include the structure of metal surfaces, adsorption on metal surfaces, the formation of oxidation products, the anodic oxidation of metals, the cathodic reduction of oxidizing agents, the electrochemical theory of corrosion, and the passive state of metals. D.M.L.

DATA SUMMARY: Diverse data are presented; variables include costs, increase in energy due to plastic deformation, degree of deformation, microhardness, electric potential, anodic polarization, rate of dissolution, adsorption, rate of corrosion.

**N77-19208*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**A DIRECTIONALLY SOLIDIFIED IRON-CHROMIUMALUMINUM-TANTALUM CARBIDE EUTECTIC ALLOY**
Fredric H. Harf Washington Mar. 1977 19 p refs
(NASA-TM-X-3434; E-8890) Avail: NTIS HC A02/MF A01 CSCL 11F

A eutectic alloy, Fe-13.6CR-3.7Al+9TaC, was directionally solidified in a high gradient furnace, producing a microstructure of alined TaC fibers in an oxidation resistant alpha-iron matrix. Tensile and stress rupture properties, thermal cycling resistance, and microstructures were evaluated. The alloy displays at 1000 C an ultimate tensile strength of 58 MPa and a 100-hour rupture life at a stress of 21 MPa. Thermal cycling to 1100 C induces faceting in the TaC fibers. Author

DATA SUMMARY: Tensile and stress rupture tests of directionally solidified, as cast, and oxide dispersion strengthened alloys; variables include nominal composition (wt %), temperature, ultimate tensile strength, yield strength, elongation, solidification rate, stress, life; 1 figure and 2 tables include numeric data.

**N77-19209*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**GASEOUS SODIUM SULFATE FORMATION IN FLAMES AND FLOWING GAS ENVIRONMENTS**
Carl A. Stearns, Robert A. Miller, Fred J. Kohl, and George C. Fryburg 1977 22 p refs Presented at Symp. on Corrosion Probl. Involving Volatile Corrosion Products, Philadelphia, 8-13 May 1977; Sponsored by the Electrochem. Soc.
(NASA-TM-X-73600; E-9029) Avail: NTIS HC A02/MF A01 CSCL 11F

Formation of $Na_2SO_4$(g) in flames and hot flowing gas systems was studied by high pressure, free-jet expansion, modulated molecular beam mass spectrometric sampling. Fuel-lean $CH_4$-$O_2$ flames doped with $SO_2$, $H_2O$ and NaCl yielded the gaseous $Na_2SO_4$ molecule in residence times of less than one millisecond. Intermediate species $NaSO_2$(g) and $NaSO_3$(g) were also observed and measured. Composition profiles were obtained for all reaction products. Nonflame flowing gas experiments showed that $Na_2SO_4$ and $NaSO_3$ gaseous molecules were formed at 1140 C in mixtures of $O_2$, $H_2O$(g), $SO_2$ and NaCl(g). Experimental results are compared with calculated equilibrium thermodynamic predictions. Author

DATA SUMMARY: Measurements of various gaseous species in flames; variables include ion intensity, burner surface to sampling orifice distance, composition, fuel/oxidant mass ratio, temperature, and equilibrium constant; 4 figures and 2 tables include numeric data.

**N77-19210*#** Northrop Corp., Hawthorne, Calif. Aircraft Div.
**STUDY TO DETERMINE PEENING STRESS PROFILE OF ROD PEENED ALUMINUM STRUCTURAL ALLOYS VERSUS SHOT PEENED MATERIAL**
R. E. Rosas and B. G. Calfin Aug. 1976 142 p refs
(Contract NAS8-31563)
(NASA-CR-150205) Avail: NTIS HC A07/MF A01 CSCL 11F

The objective of this program was to determine the peening stress profiles of rod peened aluminum structural alloys versus shot peened material to define the effective depth of the compressed surface layer. Author

DATA SUMMARY: Diverse data are presented; variables include surface stress, maximum stress/depth, zero stress depth, curvature, rod peening stress, compression yield strength, lattice spacing, impingement angle, sine of the diffraction angle, residual stress.

**N77-19211*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**CREEP DEGRADATION IN OXIDE-DISPERSION-STRENGTHENED ALLOYS**
J. Daniel Whittenberger Washington Mar. 1977 36 p refs
(NASA-TN-D-8421; E-8849) Avail: NTIS HC A03/MF A01 CSCL 11F

Oxide dispersion strengthened Ni-base alloys in wrought bar form are studied for creep degradation effects similar to those found in thin gage sheet. The bar products evaluated included ODS-Ni, ODS-NiCr, and three types of advanced ODS-NiCrAl alloys. Tensile test specimens were exposed to creep at various stress levels at 1365 K and then tensile tested at room temperature. Low residual tensile properties, change in fracture mode, the appearance of dispersoid-free bands, grain boundary cavitation, and internal oxidation in the microstructure were interpreted as creep degradation effects. This work showed that many ODS alloys are subject to creep damage. Degradation of

tensile properties occurred after very small amounts of creep strain, ductility being the most sensitive property. All the ODS alloys which were creep damaged possessed a large grain size. Creep damage appears to have been due to diffusional creep which produced dispersoid-free bands around boundaries acting as vacancy sources. Low angle and possibly twin boundaries acted as vacancy sources. Author

DATA SUMMARY: Diffusional creep and creep damage in nickel based alloys possessing large grain size; the variables include chemical composition, heat treatment, thermal stress, mechanical processing, grain size parameters, crystal structure, residual tensile properties, reduction in area, elongation, stress-strain-time relations; 3 figures and 5 tables.

**N77-19212#** Sandia Labs., Albuquerque, N.Mex.
**COMPARISON OF MECHANICAL PROPERTIES FOR SEVERAL ELECTRICAL SPRING CONTACT ALLOYS**
Terry V. Nordstrom Jun. 1976 35 p refs
(Contract AT(29-1)-789)
(SAND-75-0365) Avail: NTIS HC A03/MF A01

The mechanical properties of beryllium-nickel alloy 440 (Ni-1.95 Be-0.5 Ti) were studied to determine its suitability as a substitute for the contact alloys Paliney 7 and Neyoro G, in certain electrical contact applications. Evaluation of the alloy involved: (1) measurement of the room temperature microplastic and macroplastic behavior of alloy 440 in various age hardening conditions, (2) determination of applied stress effects on stress relaxation or contact force loss, and (3) measurement of elevated temperature mechanical properties and stress relaxation behavior. Similar measurements were also made on Neyoro G and Paliney 7 for comparison. Results show that beryllium-nickel alloy 440 is equal or superior to Paliney 7 and Neyoro G for normal Sandia requirements. For elevated temperature applications, alloy 440 has clearly superior mechanical properties. ERA

DATA SUMMARY: Mechanical properties of beryllium-nickel alloy 440, Neyoro G alloy, and Paliney 7 alloy including the effects of aging, applied stress, and temperature variables include conductivity, modulus of elasticity, yield strength, tensile strength, elongation, fatigue strength, stress, aging time, percent stress relaxation; 8 figures and 3 tables include numeric data.

**N77-19213#** Sandia Labs., Albuquerque, N.Mex.
**STRESS RELAXATION OF A HIGH-CARBON STEEL**
Henry J. Rack and M. Cohen Jun. 1976 22 p refs
(Contract AT(29-1)-789)
(SAND-76-0282) Avail: NTIS HC A02/MF A01

Stress relaxation was examined in a high carbon steel by means of wedged split-ring specimens. Enhanced relaxation arising from the redistribution and coarsening of cementite at high temperatures and/or long times was found to be independent of the applied stress, at least within the range investigated. In addition, a creepback phenomenon was observed when a sample was reheat-treated under these conditions. At lower temperatures and/or shorter times, the relaxation was a linear function of applied stress and the creepback phenomenon was absent. A dual stress relaxation mechanism is proposed wherein the enhanced relaxation and associated creepback effect are due to the generation of a plastic zone set up during the carbide precipitation, while the stress-dependent relaxation process involves general yielding of the matrix. ERA

DATA SUMMARY: Redistribution of spheroidized carbide phase at high temperature and/or long times; variables include chemical composition, temperature effect, ring dimensions, percent stress relaxation, creepback, applied loads, and kinetics; 6 figures and 11 tables.

**N77-19214#** California Univ., Berkeley. Lawrence Berkeley Lab.
**HEAT-TREATMENT, MICROSTRUCTURE AND MECHANICAL PROPERTIES OF EXPERIMENTAL HIGH STRENGTH Fe-4Cr-0.4C STEELS**
B. V. NarasimhaRao, R. W. Miller (Rockwell Intern. Corp., Downey, Calif.), and G. Thomas Dec. 1975 47 p refs Presented at 16th Intern. Heat Treatment Conf., Avon, UK of Great Britian and Northern Ireland, UK, 6 May 1976
(Contract W-7405-eng-48)
(LBL-3982; Conf-760537-1) Avail: NTIS HC A03/MF A01

The treatments involve high temperature (1100 C) austenitizing during the first solution treatment followed by either interrupted quenching (Ms-Mf range) or isothermal transformation to produce lower bainite. Finally, the steels are given a 900 C grain refinement treatment. Lower bainite was obtained by isothermally transforming austenite just above the Ms temperature. Tempering after the martensitic and bainitic treatments was also done in an attempt to improve the toughness of the material. The strength and toughness properties of as-quenched martensitic structures are somewhat superior while these properties of lower bainitic structures are comparable to those of a plain 0.4C steel. The properties of the nearly 100 percent bainite structure were unaffected by the cooling rate from the transformation temperature. Elimination of intergranular cracking produced toughness properties in quenched and tempered martensites which are far superior to those of lower bainite at the same strength level. ERA

DATA SUMMARY: Initial interrupted quenching Ms-Mf range; variables include ultimate tensile strength; percent elongation, impact energy, yield strength, temperature, time cooling rate, tempering temperature, thickness, and plane strain fracture toughness; 6 figures and 3 tables include numeric data.

**N77-19215#** California Univ., Berkeley. Lawrence Berkeley Lab.
**IMPROVEMENTS IN STRENGTH AND TOUGHNESS OF EXPERIMENTAL Fe-Cr-C STEELS**
M. F. Carlson, B. V. N. Rao, R. O. Ritchie, and G. Thomas Apr. 1976 6 p refs Presented at 4th Intern. Conf. on Strength of Metals and Alloys, Nancy, France, 30 Aug. 1976
(Contract W-7405-eng-48)
(LBL-5111; Conf-760804-1) Avail: NTIS HC A02/MF A01

Efforts to improve Fe-Cr-C steel by modification of heat treatment and alloying additions are described. An important result of this work is in the evaluation of toughness with austenitizing temperature. The resistance to fracture of the conventionally (870 C) austenitized structure is greatest ahead of a rounded notch, whereas it is least ahead of a sharp crack. Therefore, the advantages of increased fracture toughness, K/sub Ic/, with increased austenitizing temperature, must be weighed against the deterioration of ductility and Charpy impact energy. However, an optimum austenitizing temperature can be chosen (in the range 1000 to 1100 C), where a 30 to 50 percent increase occurs in fracture toughness, K/sub Ic/, with no loss of strength and little reduction in impact energy and ductility. ERA

DATA SUMMARY: Variations of mechanical properties with austenitizing temperature and quaternary alloying; variables include impact energy, yield strength, plane strain, austenitizing temperature, and quaternary alloying; 7 figures and 1 table include numeric data.

**N77-19216#** Oak Ridge Y-12 Plant, Tenn.
**EFFECT OF ELECTRICAL DISCHARGE MACHINING ON URANIUM-0.75 TITANIUM AND TUNGSTEN-3.5 NICKEL-1.5 IRON ALLOYS**
R. C. Anderson Jun. 1976 19 p refs
(Contract W-7405-eng-26)
(Y-2048) Avail: NTIS HC A02/MF A01

It was found that U-0.75 Ti alloy cracked if the EDM parameters were out of control, and precipitation of carbides adjacent to the EDM surface took place during subsequent solution quenching. Cracks form in the recast layer when solution-quenched U-0.75 Ti alloy undergoes EDM, and the cracks propagated during subsequent nickel plating. If the recast layer was removed prior to nickel plating, only a slight loss in strength resulted, compared to conventional machining. W-3.5 Ni-1.5 Fe alloy also sustained some surface damage during EDM and also experienced a small loss in strength compared to conventionally machined material. ERA

DATA SUMMARY: Tensile strength of U-0.75 Ti and W-3.5 Ni-1.5 Fe alloys that were electrically machined and conventionally machined; variables include ultimate tensile strength and

confidence interval on the mean tensile strength; 1 table includes numeric data.

**N77-19217#** Sandia Labs., Livermore, Calif.
**ADHESION OF ELECTRODEPOSITED COATING ON U-Ti AND MULBERRY**
H. R. Johnson and J. W. Dini May 1976 11 p refs Presented at High Density Penetrator Mater. Conf., Charlottesville, Va., 24-27 May 1976; Sponsored by APPA/ARMCOM/AMMRC
(Contract AT(29-1)-789)
(SAND-76-8225; Conf-760540-2) Avail: NTIS HC A02/MF A01

Quantitative test data are presented for two etched and plated uranium alloys, U-0.75 Ti and mulberry (U-7.5 Nb, 2.5 Zr). Conical head tensile tests showed that the bond between nickel plating and U-Ti was stronger than that between nickel plating and mulberry. Ring shear tests showed that electroplated nickel coatings are more adherent than other coatings applied to U-Ti. Utilizing a newly developed etchant for mulberry, large cylinders of this material were jointed to aluminum and then tensile tested. Results showed that the strength of the joint was directly influenced by the taper angle of the mulberry. ERA

DATA SUMMARY: Bonding strength data for nickel and aluminum coatings; the variables include plating solution, etching characteristics, surface finish, heat treatment, tensile strength, bonding strength, and cracking (fracturing); no figures and 4 tables.

**N77-19218#** Bettis Atomic Power Lab., Pittsburgh, Pa.
**REVIEW OF MINOR ELEMENT EFFECTS ON THE ARC AND WELD PENETRATION**
S. S. Glickstein and W. Yeniscavich May 1976 74 p refs Prepared in cooperation with Westinghouse Elec. Corp.
(Contract E(36-1)-gen-14)
(WAPD-TM-1260) Avail: NTIS HC A04/MF A01

Changes in weld penetration indifferent heats of the same material were attributed to variations of minor elements. A critical review of all the available literature indicates that the addition of halides to the base material improves weld penetration. Presence of oxygen in the weld material was reported to have both positive and negative effects. Al addition to the arc or excessive Al in the base material was observed to produce a flared arc at the anode surface. In many cases, these changes are accompanied by variations in the arc voltage which can act as a warning signal. Changes in weld penetration can be due to heat-to-heat chemical variation or to several factors which influence the arc discharge, such as electrode configuration and composition, or surface tension of the weld pool. An attempt was therefore made to provide some beginning and rationale for understanding how the properties of minor elements can affect the factors which influence weld penetration. ERA

DATA SUMMARY: Three runs per specimen (26) using cathodes, anodes, and plasmas; variables include temperature, arc current, total impurity, percent composition, maximum weld parameter, arc potential, height above anode, heat input distribution parameter, electrical resistivity, and thermal conductivity; 7 figures and 6 tables include numeric data.

**N77-19219#** Los Alamos Scientific Lab., N.Mex.
**CRYSTAL STRUCTURES OF CERIUM METAL AT HIGH PRESSURE**
W. H. Zachariasen and F. H. Ellinger Feb. 1976 10 p refs
(Contract W-7405-eng-36)
(LA-6251) Avail: NTIS HC A02/MF A01

The high pressure form of cerium metal stable above 51 kbar, alpha prime-Ce, is found to be orthorhombic with the alpha-U type of structure. At 58 kbar the cell dimensions of alpha prime-Ce are: a = 3.049 A, b = 5.998 A, c = 5.215 A. A second metastable phase of cerium metal, alpha prime prime-Ce, was also observed. It is a monoclinic body centered with a deformed, face centered cubic structure. The cell dimensions of alpha prime prime-Ce at 56 kbar are: a = 4.762 A, b = 3.170 A, c = 3.169 A, beta = 91.73 deg. The volume change at the alpha-alpha prime transition point is Delta V/V = 0.011. Cerium metal is fully tetravalent in both alpha prime-Ce and alpha prime prime-Ce. ERA

DATA SUMMARY: Variations of atomic volume with pressure; variables include angstroms, pressure, diffraction, pressure patterns, intensity, and mulitplicity; 9 tables include numeric data.

**N77-19220#** Los Alamos Scientific Lab., N.Mex.
**ANALYSIS OF EVIDENCE FOR AN IRREPRODUCIBLE MARTENSITE-LIKE BEHAVIOR IN ACTINIDE METALS AND ALLOYS BELOW ROOM TEMPERATURE**
Thomas A. Sandenaw May 1976 12 p refs
(Contract W-7405-eng-36)
(LA-6361-MS) Avail: NTIS HC A02/MF A01

Evidence is presented which suggests that a low-temperature, martensite-like behavior may be quite general in actinide metals and their alloys and compounds. There may be no metastable martensitic embryos in an alpha-phase structure of high-purity U, Np, and Pu formed by a diffusion-controlled beta yields alpha transformation, and thus no evidence for low-temperature phases. The effect of impurity content on observed low-temperature physical properties of these actinides is noted. It is proposed that impurities may be playing several roles. They may permit an electron redistribution in dilute alloys dependent upon the length of holding time. Variations in interstitial ordering of impurity atoms with processing may yield stacking variants of each basic close-packed actinide metal structure and thus determine the number and structure of low-temperature phase. ERA

DATA SUMMARY: No numeric data are presented.

**N77-19221#** Brookhaven National Lab., Upton, N.Y.
**METALLURGICAL CONSIDERATIONS IN THE PRODUCTION AND USE OF FeTi ALLOYS FOR HYDROGEN STORAGE**
G. D. Sandrock (Intern. Nickel Co., Inc., Suffern, N. Y.), J. J. Reilly, and J. R. Johnson 1976 7 p refs Presented at the 11th Intersociety Energy Conversion Engineering Conf., State Line, Nev., 12 Sep. 1976 Sponsored in part by the Intern. Nickel Co., Inc.
(Contract E(30-1)-16)
(BNL-21539; Conf-760906-12) Avail: NTIS HC A02/MF A01

Hydriding alloys based on the intermetallic compound FeTi have potential for the safe and convenient storage of hydrogen, both for mobile and stationary applications. Optimum technical and economic use of these alloys requires an understanding of the physical metallurgy of the system and its relation to the hydriding behavior. An introduction is provided to some of the metallurgical factors that affect hydriding behavior in FeTi and related alloys. Properties considered are hydrogen storage capacity, activation, decrepitation (particle size breakdown) and hydride stability (dissociation pressure). ERA

DATA SUMMARY: Effects of various transition metal substitutions and alloy oxygen content on the 40 C desorption isotherm; variables include temperature, weight percent, atomic percent, dissociation pressure, maximum hydrogen content, alloy axygen content, and equilibrium dissociation pressure; 5 figures and 1 table include numeric data.

**N77-19222#** Oak Ridge National Lab., Tenn.
**EMPIRICAL RELATIONSHIPS AMONG CREEP PROPERTIES OF FOUR ELEVATED-TEMPERATURE STRUCTURAL MATERIALS**
M. K. Booker and V. K. Sikka Jan. 1976 71 p refs
(Contract W-7405-eng-26)
(ORNL/TM-5399) Avail: NTIS HC A04/MF A01

Elevated temperature creep and creep rupture data for four important structural materials were examined to determine empirical relationships among various properties. Materials used included types 304 and 316 austenitic stainless steel, ferritic 2 1/4 Cr-1 Mo steel, and nickel-base Inconel alloy 718. Results obtained allow use of rupture life and minimum creep rate data to predict time to tertiary creep, creep ductility, and creep strain-time response. ERA

DATA SUMMARY: Creep analyses of types 304 and 316

austenitic stainless steels, ferritic 2 1/4 Cr-1 Mo steel, and Inconel alloy 718; variables include time, temperature, weight percent, stress, rupture life, creep rate, creep strain; 39 figures and 14 talbes include numeric data.

**N77-19223#** California Univ., Berkeley. Lawrence Berkeley Lab.

**DOMAIN HYPERFINE FIELDS IN SOME DILUTE FERROMAGNETIC ALLOYS STUDIED BY NMR ON ORIENTED NUCLEI Ph.D. Thesis**

R. W. Streater May 1976 91 p refs
(Contract W-7405-eng-48)
(LBL-4981) Copyright. Avail: NTIS HC A05/MF A01

Hyperfine field distributions at the sites of Co -60 atoms dissolved in some dilute (up to 4 percent) CoFe and NiFe alloys were measured by NMR on oriented nuclei at very low temperatures. The hyperfine field shifts due to neighboring impurities were shown to be consistent with a model in which the shifts are caused by moment perturbations in the neighboring shells surrounding an impurity, with RKKY-like spin density oscillations affecting the conduction electron and core polarization contributions to the hyperfine field. Small quadrupole contributions to the hyperfine interactions were shown to exist by the response in adiabatic fast passage resonance sweeps, but do not contribute significantly to the magnetic resonance lineshapes. Co -60 spin-lattice relaxation times were measured for the main and satellite resonances in some CoFe alloys and no statistically significant changes in a function of alloy concentration or the sub-resonance excited were observed. ERA

DATA SUMMARY: Nuclear magnetic resonance studies of ferromagnetic alloys; variables include average hyperfine field, concentration, counts per channel, frequency, statistical intensity ratio, spin-lattice relaxation time, reciprocal of temperature, relative intensity; 17 figures and 7 tables include numeric data.

**N77-19224#** Cornell Univ., Ithaca, N.Y. Dept. of Theoretical and Applied Mechanics.

**INELASTIC ANALYSIS OF METALLIC STRUCTURES IN THE PRESENCE OF THERMAL GRADIENTS USING NEWER CONSTITUTIVE RELATIONS**

V. Kumar and Subrata Mukherjee Feb. 1976 40 p refs Presented at Intern. Joint Pressure Vessels and Piping and Petrol. Mech. Eng. Conf., Mexico City, 19 Sep. 1976
(Contract E(11-1)-2733)
(COO-2733-3; Conf-760905-4) Avail: NTIS HC A03/MF A01

Several constitutive relations are proposed for describing the mechanical behavior of metals and alloys under elevated temperature creep conditions. A salient feature of the mathematical structure of many of these relations is that they typically express the nonelastic strain rates as functions of the current values of stress, temperature, and some other suitably defined state variables. A computational scheme is presented for the inelastic analysis of metallic structures subjected to both mechanical and thermal loadings and obeying constitutive relations of the type described above. Several numerical examples for the creep of thick-walled spheres, cylinders, and rotating discs in the presenca of thermal gradients are presented. The proposed computational scheme is found to be very efficient from the view point of both computational time and effort. The effects of previous cold work on the stress redistribution and creep of these structural elements are discussed. ERA

DATA SUMMARY: Three dimensional analysis of thick-walled spheres, cylinders, and rotating discs under steady internal and external pressures and radial temperature gradients; variables include time, radial stress, tangential stress, axial stress, strain rate, initial hardness, hardness growth, stress relaxation, and radial displacement; 8 figures include numeric data.

**N77-19225#** Sandia Labs., Albuquerque, N.Mex.

**MECHANICAL EQUATION OF STATE FOR INELASTIC SOLIDS**

R. W. Rohde and J. C. Swearengen 1976 5 p refs Presented at 2nd Intern. Conf. on the Mech. Behavior of Mater., Federation of Mater. Soc., Boston, 16 Aug. 1976 Sponsored by ERDA
(SAND-76-5442; Conf-760819-4) Avail: NTIS HC A02/MF A01

A mechanical equation of state for metals must have at least one evolutionary variable or history-dependent material property. The ability of three analytic relationships (Hart equation, reaction rate model, and power law) to meet the criteria is tested using stress relaxation in high-purity iron and Sn-50 percent In alloy. ERA

DATA SUMMARY: Stress relaxation curves subsequent to cyclic and monotonic deformation in iron and indium tin alloys; variables include applied stress, log strain rate, and strain (%); 2 figures include numeric data.

**N77-19226#** Los Alamos Scientific Lab., N.Mex.

**SOME EFFECTS OF LASER IRRADIATION ON ALUMINUM**

C. G. Hoffman Dec. 1975 25 p refs
(Contract W-7405-eng-36)
(LA-6189-MS) Avail: NTIS HC A02/MF A01

Ten samples of aluminum were irradiated by a 1.06- microns mode-locked laser (25 ps) to various energy levels. The excavations were examined by optical and scanning electron microscopy. Rough computations of the mass of metal removed indicated a relationship of energy of the laser shot to the mass removed as about 9 J/mole. In some cases, there is good evidence to indicate compression of the metal, but no values for this compression could be obtained. ERA

DATA SUMMARY: Crater dimensions versus energy in shot were tabulated; variables include pulse energy, approximate diameter of crater, approximate depth of crater, and micrograms of removed aluminum; 2 tables include numeric data.

**N77-19227#** Oak Ridge National Lab., Tenn.

**SOLUBILITY OF HYDROGEN ISOTOPES IN LITHIUM**

F. J. Smith, A. M. Batistoni, G. M. Begun, and J. F. Land 1976 5 p Presented at the 9th Symp. on Fusion Technol., Garmish-Partenkirchen, West Germany, 14 Jun. 1976
(CONF-760631-1) Avail: NTIS HC A02/MF A01

The individual solubilities of hydrogen, deuterium, and tritium in lithium were measured as a function of temperature (700 to 1000 C) and pressure (0.1 to 760 torr). The individual solubilities decrease with increasing temperature, and, for the same hydrogen isotope concentration in the molten lithium, the equilibrium gas pressures for the isotopes are of the order P sub T2 > P sub D2 > P sub H2. Equations are presented for expressing the temperature dependence of the individual solubilities for the case when the mole fraction of LiH, LiD, or LiT is less than about 0.1. The mutual solubilities of hydrogen and deuterium in lithium were measured for the plateau region at 800 C. Both the total pressure and the individual partial pressures of H2, HD, and D2 were determined as a function of the mole fraction of LiH and LiD in the lithium solution with varying hydrogen-to-deuterium ratios. Equations are presented for expressing the total and partial pressures of hydrogen and deuterium in the Plateau region at 800 C. ERA

DATA SUMMARY: Solubility of hydrogen isotopes in lithium; variables include solubility, square root of pressure; 2 tables include numeric data.

**N77-19228#** Ames Lab., Iowa.

**CALCULATION OF THE ELECTRON-PHONON SPECTRAL FUNCTION OF NIOBIUM**

B. N. Harmon and S. K. Sinha 1976 23 p refs Presented at 2nd Conf. on Superconductivity in d- and f-bands, Rochester, N. Y., 30 Apr. 1976
(Contract W-7405-eng-82)
(IS-M-75; Conf-760464-4) Avail: NTIS HC A02/MF A01

The energy bands and wave functions were obtained from a self-consistent APW muffin-tin potential, and the matrix elements were evaluated using the socalled rigid ion approximation. Details of the calculation are presented and results compared with recent tunneling experiments, which confirm that the electron-phonon interaction is nearly three times larger for transverse phonons compared to the longitudinal phonons. It is shown that screening is of great significance and evidence is given which suggests that the same screening by d-electrons which causes the dips in the phonon dispersion curves of Nb is responsible for enhancing

the electron-phonon matrix elements and hence T/sub c/. An omission in the formulas of Gaspari and Gyorffy is pointed out. ERA

DATA SUMMARY: Polycrystal tunneling results using both theoretical and experimental calculations; variables include density of states, frequency, arbitrary units, and energy; 4 figures include numeric data.

**N77-19229#** California Inst. of Tech., Pasadena. W. M. Keck Lab. of Engineering Materials.
**CONCENTRATION INDEPENDENCE OF THE MAGNETIC PROPERTIES IN AMORPHOUS Fe-P-B ALLOYS**
J. Durand May 1976 18 p refs
(Contract AT(04-3)-822)
(CALT-822-83) Avail: NTIS HC A02/MF A01

The variation with composition of the magnetic properties of amorphous Fe-P-B alloys obtained by splat-cooling is discussed. For a given Fe concentration, the magnetic moments per atom and the Curie temperature T/sub c/both increase with the substitution of B for P. The variation of magnetic moments per atom and T/sub c/ as a function of the B content had the same discontinuity as that occurring between the two phases epsilon and psilon(1) of the crystalline Fe3P/sub 1-x/B/sub x/ compounds. The variation of magnetic moments per atom and T/sub c/ was also studied when one metalloid (P or B) substitutes for Fe the other metalloid remaining constant. The value of magnetic moments per atom was found to decrease when the P or B content is increased, as expected from a rigid band model. In the same concentration range, T/sub c/ increases with either P or B. The different behaviors of magnetic moments per atom and T/sub c/ are tentatively explained by assuming that the amorphous Fe has two magnetic states (ferro and antiferromagnetic) as already suggested for crystalline Fe in a fcc environment. ERA

DATA SUMMARY: Variations of magnetic moments per atom at 4.2 K and Curie temperature as function of amorphous compounds; variables include temperature, atomic percent, mean moment per atom, and Curie temperature; 4 figures include numeric data.

**N77-19230#** Oak Ridge National Lab., Tenn.
**PALLADIUM-HYDROGEN SYSTEM**
Horst Brodowsky [1977] 12 p refs Transl. into ENGLISH from Z. Phys. Chem. (Frankfurt), v. 44, 1965 p 129-142 Sponsored by ERDA
(ORNL-TR-4175) Avail: NTIS HC A02/MF A01

The solubility of hydrogen in palladium is of interest because of the dissociation of the dissolved hydrogen atoms to protons and electrons. The difference from an ideal mixture behavior results on the one hand from filing up of the electron shell of the metal and on the other, local expansion and loading of the lattice due to the thermal motion of protons. The loading leads to an association tendency of the protons, part of which is calculated from the chemical potential of the dissolved hydrogen by the quasi-chemical method. The solubility of light and heavy hydrogen can be described in a manner completely analogous, yet the association energy of the deuterons, because of their smaller oscillation amplitude, is somewhat smaller than that of the protons. The difference in the association energies can be derived independently from an expression for the separation factor. ERA

DATA SUMMARY: Characteristics of hydrogen, palladium, and hydrogen-palladium systems; variables include overpotential, electron state, association energy, pressure, concentration; 8 figures include numeric data.

**N77-19231#** Connecticut Univ., Storrs.
**CLUSTER CARBURIZING Progress Report, 1 Jun. 1974 - 31 May 1975**
John E. Morral 1976 15 p refs
(Contract AT(11-1)-2354)
(COO-2354-2) Avail: NTIS HC A02/MF A01

Tantalum alloys containing 27 at percent Hf were vacuum carburized at 1900 K in flowing methane. The rate of carbon absorption, for methane pressure between 13 and 133 Pa, was determined from the rate of carbide formation. The rates determined by this technique were similar to those observed for the absorption of carbon in pure Ta. In a preliminary test of the cluster carburizing concept, a solutionized and quenched sample was simultaneously age hardened and carburized at 1273 K for one hour. A hardened zone, 20 microns deep, formed adjacent to the surface. The zone had a hardness of 800 KHN compared with 500 KHN for the age hardened and 300 for the solutionized alloy. These results can be applied to predicting suitable cluster carburizing conditions. ERA

DATA SUMMARY: Penetration of the HfC platelets into samples at 1900 K as function of time and methane pressure; variables include penetration distance, time, Knoop hardness, methane pressure, and carbon absorption rate; 2 figures and 1 table include numeric data.

**N77-19232#** Oak Ridge Y-12 Plant, Tenn.
**VARIABLES AFFECTING THE PROPERTIES OF TUNGSTEN-NICKEL-IRON ALLOYS**
W. G. Northcutt and D. H. Johnson 12 May 1976 28 p refs Presented at Conf. on High Density Alloy Penetrator Mater., Charlottesville, Va., 24-27 May 1976
(Contract W-7405-eng-26)
(Y/DA-6667; Conf-760540-14) Avail: NTIS HC A03/MF A01

Variables affecting the properties of W-3.5 Ni-1.5 Fe alloys are reviewed. Information is included on the effects of rolling and strain aging, prestraining, and strengthening by additional alloying. ERA

DATA SUMMARY: Response of W-3.5 Ni-1.5 Fe alloy to different metal working methods; variables include ultimate tensile strength, yield strength, elongation, reduction in area, elastic modulus, hardness, temperature, reduction in thickness, compressive prestrain; 4 figures and 4 tables include numeric data.

**N77-19233#** Rensselaer Polytechnic Inst., Troy, N.Y. Dept. of Materials Engineering.
**PITTING AND STRESS CORROSION CRACKING BEHAVIOR OF AUSTENITIC STAINLESS STEEL WELDMENTS CONTAINING RETAINED FERRITE Technical Progress Report, 1 Jun. 1975 - 31 May 1976**
D. J. Duquette and W. F. Savage 1976 7 p ref
(Contract AT(11-1)-2462)
(COO-2462-2; TPR-2) Avail: NTIS HC A02/MF A01

The critical pH for pitting protection is 8.5 for weld metal, 11.5 for as-received 304L ss. Re-passivation potentials measured using potentionkinetic scanning and after long-term testing were found not to be reproducible and accurate. Slow-strain-rate stress corrosion cracking (SCC) test of as-received and welded 304L and 304 as were conducted in boiling MgCl2 solutions. The decreased strain rate led to increased SCC. The 304L ss exhibited intergranular failure below 135 C and transgranular failure at 154 C. A specimen containing a transverse weld failed in the heat affected zone when tested in liquid paraffin; in boiling MgCl2, the failure occurred in the fusion zone. In boiling saturated NaCl, SCC occurred in as-received as only at pH less than 2.5 and slowest strain rate, and in weld metal only at pH less than 1.0 and slowest strain rate, but H2SO4 or HCl + NaCl induces susceptibility. ERA

DATA SUMMARY: No numeric data are presented.

**N77-19234#** Sandia Labs., Albuquerque, N.Mex.
**DEPTH DISTRIBUTION AND MIGRATION OF HELIUM IN VANADIUM AT ELEVATED TEMPERATURES**
Robert S. Blewer and R. A. Langley 1976 24 p refs Presented at the 2nd Intern. Conf. on Surface Effects in Controlled Fusion Devices, San Francisco, 16 Feb. 1976
(Contract AT(29-1)-789)
(SAND-75-6189; Conf-760209-28) Avail: NTIS HC A02/MF A01

The depth profiles and retention behavior of He implanted at 80 keV into vanadium were investigated in cold rolled bulk and foil samples. The specimens were implanted at temperatures of 100, 400, and 800 C and at fluences up to 1 x 10 to the 18th power He/cm2. Helium depth distributions were found to

be Gaussian for the 100 C implants but exhibited a double peak appearance for some of the highest fluence 400 and 800 C implants. In polished samples blistering and flaking occurred at both 100 and 400 C implant temperatures for fluences greater than 5 x 10 to the 17th power He/cm2, but little of the implanted helium appeared to have been released as a result of the exfoliation. Conversely, most of the implanted helium was released from 800 C implant areas though no significant blistering or surface perforation was observed. Blistering was observed to occur only on polished samples, though the release behavior was similar to that of the unpolished specimens on which no blistering was observed. ERA

DATA SUMMARY: Depth and retention of helium implanted in vanadium; variables include helium retained, fluence, depth, annealing temperature, normalized damage density, mean bubble radius, bubble concentration; 4 figures include numeric data.

**N77-19235#** California Univ., Berkeley. Lawrence Berkeley Lab. Div. of Materials and Molecular Research.
**EFFECT OF TEMPERING ON THE STRENGTH AND TOUGHNESS OF A SERIES OF Fe-Cr-Si-C ALLOYS**
E. A. Wylie Jan. 1976 45 p refs
(Contract W-7405-eng-48)
(LBL-4574) Avail: NTIS HC A03/MF A01

The mechanical properties of a series of high strength Fe-Cr-C alloys with silicon additions of 1.5, 2.0 and 3.0 percent were determined for the as-quenched and the tempered conditions. By allowing tempering to take place at higher temperatures without the nucleation and growth of the non-coherent iron carbide, increased internal stress relief can be accomplished. The resulting combination of strength and toughness of these alloys, which was developed using a conventional quench and temper heat treatment, allows them to be classified near the high strength-high toughness band of the 18 Ni maraging steels. The fracture toughness of these alloys is higher than that of the current high strength, low alloy steels at the same strength levels. Results of the investigations show that iron alloys with superior properties can be designed from the metallurgical understanding of simple alloy systems. ERA

DATA SUMMARY: Effect of silicon addition on mechanical properties of high strength iron alloy during tempering; the variables include chemical composition, tempering temperature, hardness, tensile strength, yield strength, elongation, reduction in area, fracture toughness, and percent carbon; 6 figures and 2 tables.

**N77-19236#** Oak Ridge National Lab., Tenn.
**EFFECT OF LONG-TERM AGING AT 815 DEG C ON THE TENSILE PROPERTIES AND MICROSTRUCTURAL STABILITY OF FOUR COBALT - AND NICKEL-BASE SUPERALLOYS**
J. P. Hammond Aug. 1976 31 p refs
(Contract W-7405-eng-26)
(ORNL-5174) Avail: NTIS HC A03/MF A01

Two heats of Haynes alloy 25 and one heat each of Haynes alloy 188, Hastelloy N, and Inconel 625 were tensile tested after aging for 11,000 h at 816 C. Yield strength, ultimate tensile strength, and elongation were determined at 24, 316, 760, and 982 C and compared with typical properties for these materials in the solution annealed condition. Toughness values were determined for these materials from their engineering stress-strain curves. The long term aging treatment degraded ductility and toughness at room temperature but, contrary to behavior expected for overaging, enhanced them over those for the solution annealed condition in tests at 760 C. The tensile properties of the aged superalloys were correlated with mode of fracture and the amounts, identity, and morphology of the precipitates. Aging substantially depleted the hardener tungsten from the matrix in the cobalt-base alloys. ERA

DATA SUMMARY: Overaging effects on mechanical properties of superalloy containment materials for nuclear power plants; the variables include alloy composition, temperature effects, stress-strain-time relations, yield strength, annealing, tensile strength, elongation, deformation energy, fracture modes, and ductility; 9 figures and 3 tables.

**N77-19237#** California Univ., Livermore. Lawrence Livermore Lab.
**HOLOGRAPHIC DETERMINATION OF THE YIELD STRENGTH OF A WELDED STAINLESS STEEL PRESSURE VESSEL**
M. D. Meyer 14 Jul. 1976 15 p ref
(Contract W-7405-eng-48)
(UCID-17247) Avail: NTIS HC A02/MF A01

The strength and toughness of a high energy rate formed stainless steel, as influenced by the heat input from a variety of welds, are being measured. Using holographic interferometry, a welded spherical pressure vessel constructed from stainless steel with a composition of 21 percent Cr, 6 percent Ni, 9 percent Mn, 0.23 percent N, balance Fe was examined. Holographic examination of the weld vicinity shows that plastic deformations in the heat affected zones reach a maximum at a distance of 5 mm on either side of the weld, and tails off for another 20 mm to zero strain. The yield and ultimate strengths of the heat affected zones, based on the thin wall relation and using the wall thickness just above the weld, is nearly that of the parent material. However, the mode of deformation indicates that if the heat affected zones were either higher strength or narrower, the pressure vessel would be stronger. ERA

DATA SUMMARY: Plastic deformation in heat affected weld zones; the variables include angle (degree), plastic deformation, internal pressure, yield strength, temperature effects, and stress-strain-time relation; 3 figures and no tables.

**N77-19238#** California Univ., Berkeley. Lawrence Berkeley Lab. Div. of Materials and Molecular Research.
**SUPERCONDUCTORS BY POWDER METALLURGY TECHNIQUES**
Milton R. Pickus and J. Ling-Fai Wang May 1976 16 p refs Presented at Symp. on Evaluating and Controlling the Corrosive Effects of Chlorides on Reinforced Steel in Concrete, Chicago, 30 Jun. 1976
(Contract W-7405-eng-48)
(LBL-5121; Conf-760658-2) Avail: NTIS HC A02/MF A01

Fabrication methods for Nb3Sn type compounds are described. Information is included on the Bell Telephone process, the General Electric tape process, superconductor stability, the bronze process, powder metallurgy multifilamentary tapes and wires, and current assessment of powder metallurgy superconducting wire. ERA

DATA SUMMARY: Production of cladded multifilament niobium stannide wire; the variables include chemical composition, electrical resistivity, temperature effects, magnetic fields, current density, and phase diagrams; 3 figures and 1 table.

**N77-19239#** Mound Lab., Miamisburg, Ohio.
**SUITABILITY OF TOPHET C-ALLOY 52/KOVAR COMPONENTS TO HYDROGEN ENVIRONMENTS**
James M. Gebhart and Michael D. Kelly 22 Jun. 1976 13 p
(Contract E(33-1)-GEN-53)
(MLM-2289) Avail: NTIS HC A02/MF A01

The suitability of Tophet C-Alloy 52/Kovar weldments to hydrogen embrittlement were investigated because of their potential as candidate materials in fabrication of miniaturized initiators for pyrotechnics. Cathodic charged samples were statically loaded for extended periods of time resulting in no load failures and in ductile fracture surfaces indicating resistance to hydrogen embrittlement. ERA

DATA SUMMARY: Hydrogen embrittlement resistance of steel/Kovar weldments; the variables include stress intensity (K), failure time, break strength, hydrogen content, applied load (kg), and static load; 6 figures and 1 table.

**N77-19240#** Ames Lab., Iowa. Dept. of Materials Science and Engineering.
**CRYSTALLOGRAPHY OF PREFERRED GROWTH IN LEAD-TIN ALLOYS M.S. Thesis**
David Paul Mourer Jun. 1976 65 p refs
(Contract W-7405-eng-82)
(IS-T-718) Avail: NTIS HC A04/MF A01

The preferred growth of the lead-tin eutectic alloy was studied

by use of electron channeling techniques in a scanning electron microscope. Four distinct crystallographic modes were found to exist depending on the imposed growth velocity. The extent of the range of the stability of each mode was experimentally determined in a directional solidification apparatus and rationalized in terms of simple physical reasoning. Microstructural observations are discussed in terms of the nature of the extent of the stability of the various crystallographic relationships. Lamellar spiraling about the growth direction was found to occur in one crystallographic mode and the parameters controlling it, growth velocity and temperature gradient, were investigated. The rate of lamellar spiraling was found to increase by increasing solidification rate or temperature gradient. ERA

DATA SUMMARY: Solidification of lead-tin eutectic alloys; variables include growth direction, interface, crystallography present, length solidified, number of grains present, solidification rate, thermal gradient, and lamellar spiraling rate; 1 figure and 3 tables include numeric data.

**N77-19241#** Sandia Labs., Albuquerque, N.Mex. Passive Components Div.

**TWO TECHNIQUES FOR CHARACTERIZING SURFACES FOR ADHESIVE BONDING**

Charles W. Jennings May 1976 35 p refs
(Contract AT(29-1)-789)
(SAND-76-0137) Avail: NTIS HC A03/MF A01

Beta backscatter and radiochemical evaporative rate analysis were used to rapidly distinguish between different surface treatments given to aluminum and stainless steel alloy specimens prior to adhesive bonding, and to monitor the reproducibility of a particular treatment. Consistency of polishing or sandblasting of chromate etched specimens was measured in a few minutes by beta backscatter using a C-14 (0.155 MeV) source. Beta backscatter counts with a high output C-14 source were 15 percent lower for sandblasted than polished surfaces. The effect of anodizing, change in alloy composition, and residual polymer film on a metal surface was readily detected by beta backscatter. Reproducibility of the chemical state of surfaces was monitored by radiochemical evaporative rate analysis using C-14 labeled compounds. Contaminated surfaces were detected in 1 to 4 minutes. The effect of plasma treatment on silicone surfaces and chemical treatment of Teflon surfaces was shown by differences in surface radiochemical retention. The relative levels of adsorption sites on aluminum and stainless steel surfaces was demonstrated by following the retention of single additions of radiochemical over long intervals and by saturating the surfaces with radiochemical. ERA

DATA SUMMARY: Backscattering and radiochemical analyses were performed on aluminum and stainless steel alloys to evaluate different surface treatments; variables include beta backscatter counts, standard deviation, film thickness, solubility parameter, time; 12 figures and 2 tables include numeric data.

**N77-19242#** California Univ., Berkeley. Lawrence Berkeley Lab.

**OPTICAL MICRODIFFRACTION IN LATTICE IMAGE ANALYSIS**

R. Gronsky, R. Sinclair, and G. Thomas May 1976 4 p refs Presented at the 34th Electron Microscopy Soc. of Am. Annual Meeting, Miami Beach, Fla., 8-13 Aug. 1976
(LBL-4964; Conf-760803-5) Avail: NTIS HC A02/MF A01

Data from two experiments are presented to illustrate the use of laser optical microdiffraction in metallurgical analysis: ordered Mg3Cd and spinodal Au-Ni alloys. ERA

DATA SUMMARY: No numeric data are presented.

**N77-19243#** Johns Hopkins Univ., Baltimore, Md.

**ORIGINS IN EXPERIMENT OF A NEW GENERAL THEORY OF PLASTICITY FOR STRUCTURAL METAL ALLOYS**

James F. Bell Aug. 1976 40 p refs
(Contract DAAD05-74-C-0766; DA Proj. 1W6-62618-AH-80)
(AD-A029845; BRL-CR-311) Avail: NTIS HC A03/MF A01 CSCL 11/6

In this paper the author's theory of elastic-plastic deformation at large strain is reviewed. A parabolic description is found to apply to structural metal alloys as well as pure metals. The origins in experiment are emphasized. GRA

DATA SUMMARY: No numeric data are presented.

**N77-19244#** Aerospace Corp., El Segundo, Calif. Material Sciences Lab.

**EFFECTS OF THERMAL-MECHANICAL PROCESSING ON THE MICROYIELD STRENGTH OF INVAR Interim Report**

E. G. Wolfe, C. S. Susskind, and D. L. Dull Aug. 1976 33 p refs
(Contract F04701-75-C-0076)
(AD-A029980; TR-0076(6950-07)-5; SAMSO-TR-76-191) Avail: NTIS HC A03/MF A01 CSCL 11/6

Microyield strengths (MYS) were determined for 20- and 40-mil Invar sheet, 0.5-in.-diam rod, and 0.5-in.-diam (1/32 wall thickness) tube using resistance strain gages. The various shapes were also characterized in terms of metallography and mechanical properties. Several heat treatments were studied for each shape. The MYS ranged from 9 to 31 ksi (62 to 214 MPa). Stretched sheet had the highest MYS. Slow furnace cooling increased the MYS of rod and tube. Stress versus plastic strain curves were characterized by the logarithmic relationship sigma K Epsilon (N)(P). Two sets of K and n (below and above the MYS) were determined for sheet with 2% stretching. Author (GRA)

DATA SUMMARY: Microyield strength and mechanical properties test were conducted on sheet and rod specimens of Invar; variables include chemical composition, heat treatment, plastic strain, time at stress, applied stress, permanent deformation, microyield strength, yield strength, ultimate tensile strength, Young's modulus, and elongation; 3 figures and 4 tables include numeric data.

**N77-19245#** Air Force Materials Lab., Wright-Patterson AFB, Ohio.

**SOME OBSERVATIONS OF THE RELATION BETWEEN CHEMICAL SURFACE TREATMENTS AND THE GROWTH OF ANODIC BARRIER LAYER FILMS Final Report, Jun. - Dec. 1975**

Neil T. McDevitt and William L. Baun Jun. 1976 21 p refs (AF Proj. 7340)
(AD-A029968; AFML-TR-76-74) Avail: NTIS HC A02/MF A01 CSCL 11/6

Composite oxide films on bare 2024-T3 aluminum were produced by surface chemical treatments followed by anodic oxidation in a barrier forming electrolyte. The chemical characteristics of the composite film are studied. This type of information can be important in determining the overall corrosion resistance and durability of adhesively bonded structures. GRA

DATA SUMMARY: Spectrum of various etched surfaces and barrier layer films; variables include mass, energy, ratio, and chemical composition; 6 figures include numeric data.

**N77-19246#** Hitchiner Mfg. Co., Inc., Milford, N.H.

**MACHINE CASTING OF FERROUS ALLOYS Final Report, 1 Feb. 1973 - 27 Feb. 1976**

G. D. Chandley and Gary Scholl Aug. 1976 58 p refs
(Contract DAAG46-73-C-0112; ARPA Order 0112)
(AD-A030537; AMMRC-CTR-76-23) Avail: NTIS HC A04/MF A01 CSCL 13/8

This final report of a three-year program contains some highlights of the earlier reports and much detail about Rheocasting and the casting of aluminum containing superalloys by Hitchiner's patented CLA process. Aluminum castings were made using metal up to about 25% solid and steel castings using 10% solid metal were also made. No improvement in casting quality was noted in either case. GMR 235 and Inco-713LC alloys cast by CLA showed excellent properties. Some of these turbine wheels submitted to a major turbocharger manufacturer passed the qualification test. Low pressure reusable mold processes for casting ferrous alloys were not economical because of inadequate die life and hot tearing of the castings. Author (GRA)

DATA SUMMARY: Nominal composition and mechanical properties of various heat resistant alloys; variables include percent

solid, temperature, and stress rupture; 1 figure and 2 tables include numeric data.

**N77-19247#** National Bureau of Standards, Washington, D.C. Office of Standard Reference Materials.
**CRITICAL SURVEYS OF DATA SOURCES: ELECTRICAL AND MAGNETIC PROPERTIES OF METALS Final Report**
M. J. Carr, R. B. Gauert, R. L. Moore, H. W. Wanrousck, and J. H. Westbrook Jul. 1976 92 p Sponsored in part by GE, Schenectady, N. Y.
(PB-258557/8; NBS-SP-396-4; LC-76-18879) Avail: NTIS HC A05/MF A01 CSCL 11F

A directory is provided of authoritative sources of numerical data on the electrical and magnetic properties of metals, with emphasis on commercial alloys. Fifty-nine sources, including handbooks and other publications, information centers, trade associations, and technical societies are described in detail, including information on the properties and materials covered and the criteria used in the selection of data. A few additional related publications are listed with brief descriptions. GRA

DATA SUMMARY: No numeric data are presented.

**N77-19248#** United States Steel Corp., Monroeville, Pa. Research Lab.
**EFFECT OF CRYSTALLOGRAPHIC TEXTURE, RETAINED AUSTENITE, AND AUSTENITE GRAIN SIZE ON THE MECHANICAL AND BALLISTIC PROPERTIES OF STEEL ARMOR PLATES Final Technical Report, 1 Jul. 1975 - 30 Jun. 1976**
Hsun Hu, G. R. Speich, and R. L. Miller Jul. 1976 81 p refs (Contract DAAG46-75-C-0094; DA Proj. 1T1-62105-AH-84) (AD-A029415; AMMRC-CTR-76-22; Rept-76-H-018) Avail: NTIS HC A05/MF A01 CSCL 19/4

The ballistic performance of a medium-carbon 5Ni-Si-Cu-Mo-V steel processed to plates with various degrees of textures, various amounts of retained austenite, and various austenite grain sizes has been studied. Results show that, with 0.50 caliber projectiles and 0 degree obliquity, the V50 ballistic limit of nearly random-textured plates is around 2030 to 2100 fps (666 to 689 mps), at a hardness of about 53.5 to 54.5 RC. For approximately the same hardness and in-plane mechanical properties, the ballistic limit of strongly (112) - (111) textured plates increased with increasing texture intensity. A ballistic limit of about 2360 fps (774 mps) was observed for the strongest texture produced in plates rolled 80 to 90 percent at 1500 F (815 C) before quenching. With this increased ballistic limit, the tendency for spalling also increased. At a constant strain rate, the spalling resistance appears to correlate qualitatively with the through-thickness notched tensile strength. Tempering quenched plates with a random texture at various high temperatures (1100 to 1300 F or 593 to 704 C) to vary the retained-austenite contents greatly reduced the ballistic limit, primarily because of the lowered hardness. For this range of low hardness and low ballistic limit, the latter increased with increasing retained-austenite contents, but with decreasing hardness. GRA

DATA SUMMARY: Effects of texture, retained austenite, and prior austenite grain size on the properties of quenched and tempered plates; variables include tensile strength, reduction in area, total elongation, yield strength, hardness, texture intensity, retained austenite, grain diameter, ballistic limit; 4 figures and 13 tables include numeric data.

**N77-19249#** Solar, San Diego, Calif.
**DEVELOPMENT OF LOW-COST, HIGH-STRENGTH HOT-CORROSION-RESISTANT IRON ALUMINUM-BASE ALLOYS Final Report**
E. R. Duffy and J. F. Nachman Jun. 1976 94 p refs
(Contract DI-BM-H0232063)
(PB-259253/3; RDR-1813-4; BM-OFR-112-76) Avail: NTIS HC A05/MF A01 CSCL 11F

Fe-Al-Mo alloys with sufficient high temperature strength to be competitive with stainless steels for oxidizing and/or hot corrosive environments. An 8 percent aluminum alloy, which exhibited good room temperature ductility, had superior strength at 815 C and oxidation resistance equivalent to type 321 stainless steel. High aluminum (12 to 15 percent) alloys showed outstanding oxidation resistance as high as 1,370 C, but need more study to improve thermomechanical processing and strength. GRA

DATA SUMMARY: Room temperature ductility, high temperature strength, and oxidation resistance of iron alloy compositions containing 8 percent aluminum and 6 percent molybdenum; the variables include chemical composition, static oxidation, cyclic oxidation, thermal stress, surface treatment, tensile strength, yield strength, elongation, reduction in area, carbide weight percent, stress-strain diagrams, stress rupture life, and mechanical properties; 22 figures and 6 tables.

**N77-19250#** British Steel Corp., Sheffield (England). Information Services.
**THE EFFECT OF COOLING RATE AFTER ROLLING, DEFORMATION AFTER THE HOLD AND FINISH ROLLING TEMPERATURE ON THE MECHANICAL PROPERTIES AND MICROSTRUCTURE OF A C/Mn/Si/Nb STEEL**
P. S. Mitchell and R. C. Irani Aug. 1976 21 p refs
(PB-258939/8; GS/PROD/320/1/96/C) Avail: NTIS HC A02/MF A01 CSCL 11F

The effects on the mechanical properties and microstructure of cooling rate and deformation after the hold during controlled rolling at finish rolling temperatures of 1000 C, 800 C and 650 C have been determined on 0.90%/C/0.23%/Si/1.26%/Mn/0.022% Nb steel. Accelerating the cooling rate up to 4C/sec after rolling was not detrimental. Furthermore significant improvements (up to 35C) in ITT, were observed in material finish rolled at 1000C deformed 50% and 67% after the hold and cooled in the range 3-7C/Sec. To achieve a reasonable level of impact and tensile properties in material finish rolled at 650C it is important to maximize the deformation after the hold. The relationship between microstructure and mechanical properties is discussed and shown to be complex. GRA

DATA SUMMARY: Effects of accelerated cooling after rolling on cerium treated silicon-killed C/Mn/Nb steel; the variables include grain size distribution, yield strength, transition temperature, plastic deformation, cooling rate, temperature effects, tensile properties, impact properties, martensite, and pearlite; 5 figures and 5 tables.

# 27 NONMETALLIC MATERIALS

Includes physical, chemical, and mechanical properties of plastics, elastomers, lubricants, polymers, textiles, adhesives, and ceramic materials.

**N77-19251*#** Little (Arthur D.), Inc., Cambridge, Mass.
**DEVELOPMENT AND PRODUCTION OF A FLAME RETARDANT, GENERAL PURPOSE, PRESSURE SENSITIVE ADHESIVE TAPE Final Report**
P. B. Monaghan and R. H. Doggett Feb. 1977 17 p
(Contract NAS9-14873)
(NASA-CR-151224; ADL-79135) Avail: NTIS HC A02/MF A01 CSCL 11A

The specification results for the finished tape properties were as follows: (1) adhesive strength (180 deg peel) on aluminum from 107 to 143 grams per centimeter (0.6 to 0.8 pounds per inch); (2) adhesive strength (180 deg peel) on stainless steel from 71 to 107 grams per centimeter (0.4 to 0.6 pounds per inch); (3) unwind resistance of 536 to 714 grams per centimeter (3 to 4 pounds per inch); (4) tensile strength minimum of 7143 grams per centimeter (40 pounds per inch); (5) elongation from 5 to 10% at break; (6) tear strength, Elmendorf from 200 to 350 grams (0.44 to 0.77 pounds); and (7) tear strength, tongue from 363 to 408 grams (0.8 to 0.9) pounds). Author

DATA SUMMARY: Adhesives including decabromo biphenyl oxide, are tested for flame retardant abilities; variables include percent by weight, tape properties, and parts by weight; 6 tables include numeric data.

**N77-19252*#** Kanner (Leo) Associates, Redwood City, Calif.
**HOT MECHANICAL PROPERTIES OF REFRACTORIES: COMPRESSIVE STRENGTH**

B. Clavaud Washington NASA Mar. 1977 20 p refs Transl. into ENGLISH from Bull. Soc. Franc. Ceram. (Paris), v. 109, 1975 p 49-58
(Contract NASw-2790)
(NASA-TT-F-17410) Avail: NTIS HC A02/MF A01 CSCL 11G

Compressive strength was determined for refractories containing Al2O3. An apparatus and its use are described.
Author

DATA SUMMARY: Hot compressive strength tests on sintered refractories; the variables include aluminum oxide content, high temperature effects, crystal density, rupture strength, vitreous phase, silica content, porosity, titanium oxide content, chromium-magnesium agglomerate, mechanical resistance, intergranular binding, and creep; 21 figures and no tables.

**N77-19253*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**EFFECT OF ION-PLATED FILMS OF GERMANIUM AND SILICON ON FRICTION, WEAR, AND OXIDATION OF 52100 BEARING STEEL**
Donald H. Buckley and Talivaldis Spalvins Mar. 1977 11 p refs
(NASA-TN-D-8436; E-8953) Avail: NTIS HC A02/MF A01 CSCL 11G

Friction and wear experiments were conducted with ion plated films of germanium and silicon on the surface of 52100 bearing steel both dry and in the presence of mineral oil. Both silicon and germanium were found to reduce wear, with germanium being more effective than silicon. An optimum film thickness of germanium for minimum wear without surface crack formation was found to be approximately 400 nanometers (4000 A). The presence of silicon and germanium on the 52100 bearing steel surface improved resistance to oxidation. Author

DATA SUMMARY: Ion plated metal lubricant films for reducing bearing steel wear; the variables include coefficient of friction, film thickness, rider wear, silicon films, germanium films, and sliding velocity; 3 figures and no tables.

**N77-19254#** Rockwell International Corp., Anaheim, Calif.
**EFFECT OF HEAT AGEING AND RELATED PHENOMENON ON THE BLACK OXIDE-EPOXY BOND**
W. S. DeForest, H. V. Connelly, and J. Marro Feb. 1977 21 p refs Presented at NEPCON '77 West Intern. Microelectronics Conf., Anaheim, Calif., 1-3 Mar. 1977
(X77-151/101) Avail: NTIS HC A02/MF A01

Tests show that bonding between epoxy prepreg and a black oxide coating on copper foil is more heat resistant and stronger than bonding to untreated foil. Thermal testing degrades the black oxide bond appreciably, but to a level no lower than the untreated foil. Black oxide, when properly applied, is suitable for use on any epoxy MLB provided it can be justified economically.
Author

DATA SUMMARY: Results of tests to determine the strength of black oxide epoxy bonds; variables include vertical peel strength, percent original bond retained, number of solder cycles, hot oil, immersion time thermal cycles, time, temperature; 5 figures and 1 table include numeric data.

**N77-19255#** Union Carbide Corp., Tarrytown, N.Y.
**UNION CARBIDE CELLULAR SILICONES Final Report**
F. A. Smith Aug. 1972 46 p Sponsored by ERDA. Prepared for Lawrence Livermore Lab., Calif.
(UCRL-13500) Avail: NTIS HC A03/MF A01

An improved base for cellular silicone materials was developed which utilizes end-blocked polysiloxane gum. Use of the material results in better reproducibility of properties from lot to lot, better processing properties, and lower compression set values. Products are superior to standard cellular silicone materials with respect to reproducibility of the gum, base compound, and final cellular cushions. The new materials also possess good processibility, easily meeting dimensional tolerances over a long period of compound storage. Tests show improved plastic flow and a reduction in the molding pressures required to make complicated shapes. These new cellular silicone compounds permit the manufacture of silicone rubber cushions which have the lowest compression set test values ever obtained. The new materials recovered all but 6 to 10 percent of the standard test deformation of 50 percent for 22 hours at 300 F.
ERA

DATA SUMMARY: Diverse data are presented; variables include hardness, elongation, tensile strength, modulus, compression set, density, Williams plasticity, vinyl concentration, catalyst concentration, load deflection.

**N77-19256#** Los Alamos Scientific Lab., N.Mex.
**NATURE OF RADIATION DAMAGE IN CERAMICS**
J. M. Bunch 1976 17 p refs Presented at CTR Insulator Meeting, Los Alamos, N. Mex., 17 May 1976
(Contract W-7405-eng-36)
(LA-UR-76-1298; Conf-760558-4) Avail: NTIS HC A02/MF A01

Efforts to determine the equivalence between different sources of radiation damage in ceramics are reviewed. The ways in which ceramics differ from metals are examined and proposed mechanisms for creation and stabilization of defects in insulators are outlined. Work on radiation damage in crystalline oxides is summarized and suggestions for further research are offered.
ERA

DATA SUMMARY: Maximum pko energies for 1 MeV neutrons in Al, Fe, and Mo; variables include universal energy loss, projected energy, loss rate in Al2O3, maximum ionization density in carbon, and regional width with ionization density; 4 figures and 1 table include numeric data.

**N77-19257#** Los Alamos Scientific Lab., N.Mex.
**STRUCTURAL EFFECT IN NEUTRON IRRADIATION OF INSULATING CERAMICS**
G. F. Hurley 1976 10 p refs Presented at CTR Insulator Meeting, Los Alamos, N. Mex., 17 May 1976
(Contract W-7405-eng-36)
(LA-UR-76-1131; Conf-760558-1) Avail: NTIS HC A02/MF A01

A vacuum gap irradiation capsule was designed and built to maintain a temperature of 740 C during 6 weeks irradiation at EBR-2. Sixty-eight samples of 15 ceramic or metal-ceramic combinations were irradiated to a fluence of approximately 3 x 10 to the 21st power neutrons/sq cm, E greater than 0.1 MeV. Measurements of sample dimensions before and after irradiation were used to determine volume swelling. This parameter and the physical appearance of the samples are discussed. A primary application of insulating ceramics in proposed fusion powder devices is the first wall insulating lining in the RTPR reactor. A satisfactory material for this application must bear substantial thermal stresses in cyclical fashion. Calculated values of pertinent parameters are presented and compared for several of the irradiated materials in nonirradiated form. Work to prepare apparatus for the measurement of thermal and mechanical properties of these materials following neutron irradiation is described.
ERA

DATA SUMMARY: Average values of swelling for 11 materials are given; variables include pressure, temperature, percent volume change, structure, and density; 2 tables include numeric data.

**N77-19258#** Sandia Labs., Albuquerque, N.Mex.
**THERMOCHEMICAL STRESS RELAXATION IN NONLINEAR VISCOELASTIC SOLIDS**
Jace W. Nunziato and John G. Curro 1975 13 p refs Presented at 7th Intern. Congr. of Rheol., Gothenburg, Swed., 23 Aug. 1976 Sponsored by ERDA
(SAND-75-5941; Conf-760818-1) Avail: NTIS HC A02/MF A01

Thermochemical stress relaxation in isotropic, chemically reacting, viscoelastic materials is considered. Because of the difficulty in interpreting stress relaxation data in terms of this general, nonlinear theory, attention is restricted to incompressible elastomers and a specific form of the theory is formulated for analysis. It is shown how measurements of the axial stress for various extensions and initial temperature can be used, along with the model, to determine the relevant relaxation functions

and the kinetics of the chain scission reactions taking place during the experiments. Specific calculations are carried out for Viton rubber. ERA

DATA SUMMARY: Stress relaxation measurements made on a fluorocarbon rubber, Viton; variables include time, pressure, temperature, and absolute chain density; 3 figures include numeric data.

**N77-19259#** Bendix Corp., Kansas City, Mo.
**AUTOMATIC π-NETWORK ANALYZER AS A SUPPORT TOOL FOR ENGINEERING AND MANUFACTURING**
J. L. Taylor Aug. 1976 105 p
(Contract E(29-1)-613)
(BDX-613-1297-Rev) Avail: NTIS HC A06/MF A01

Use of a Hewlett-Packard Model 8542-A automatic network analyzer, with selected options, has resulted in significant direct cost savings and indirect benefits to product quality. The analyzer is not only more rapid than manual RF measurement methods, but the improved accuracy and the many additional measurements performed by the automatic analyzer provide more-complete engineering data, thereby improving product quality. Additional benefits are anticipated from adoption of a similar analyzer for manufacturing in-process and final inspection operations. ERA

DATA SUMMARY: Standard test board with complete ground plane directly related to radio frequency leakage; variables include parameter values, reflection, angle, gain, phase, frequencies, isolation (decibels), and time; 3 figures and 8 tables include numeric data.

**N77-19260#** Bendix Corp., Kansas City, Mo.
**THERMALLY CONDUCTIVE SYNTACTIC FOAM**
H. M. McIlroy Aug. 1976 35 p refs
(Contract E(29-1)-613)
(BDX-613-1409-Rev) Avail: NTIS HC A03/MF A01

A low density, high thermal conductivity syntactic foam was formulated from carbon and graphite microballoons with a polyimide binder resin and graphite fibers. The flexural properties of strength and deflection were increased by using the graphite fibers, and the failure mode was increased from a brittle to an elastic mode. ERA

DATA SUMMARY: Density versus compressive strength and modulus of foams made from Kerimid 601 and carbon microspheres; variables include temperature, time, weight loss, density, compressive strength, compressive modulus, thermal conductivity, heating rate, float/sink ratio, and ash content; 8 figures and 6 tables include numeric data.

**N77-19261#** Cornell Univ., Ithaca, N.Y.
**ANOMALOUS THERMAL PROPERTIES OF GLASSES AT LOW TEMPERATURES**
G. L. Salinger (Rensselaer Polytechnic Inst.) and R. O. Pohl 1976 46 p refs
(COO-3151-61) Avail: NTIS HC A03/MF A02

It is shown that specific heat measurements above 0.1 K indicate a distribution of local modes independent of energy; ultransonic attenuation at low powers indicate that the local mode systems can have at most a few levels; ultrasonic velocity measurements give information about phonon-local mode coupling parameters; the measured thermal conductivity agrees with that calculated from the above information assuming that the energy independent distribution of modes observed in the specific heat is responsible for phonon scattering; thermal expansion and far infrared experiments indicate a phonon assisted tunneling model; several experiments, however, indicate that the modes observed in the specific heat measurements may not all scatter phonons. Author (ERA)

DATA SUMMARY: Low temperature thermophysical properties of glassy materials; the variables include specific heat, thermal conductivity, vitreous materials, density (mass/volume), acoustic attenuation, sound velocity, light velocity, thermal expansion, temperature effects, and absorption; 20 figures and no tables.

**N77-19262#** Oak Ridge Y-12 Plant, Tenn.
**DETERMINATION OF THE KINETICS OF CURING AND THE HEAT CAPACITY OF AN EPOXY RESIN BY DIFFERENTIAL SCANNING CALORIMETRY**
J. A. Basford Aug. 1976 30 p refs
(Contract W-7405-eng-26)
(Y-2051) Avail: NTIS HC A03/MF A01

Techniques were developed for determining the kinetic parameters of chemical reactions from differential scanning calorimeter data. In one technique, variation with time of the heat gain or loss as reactions proceed can be used to determine the order, rate constant, activation energy, and heat of reaction. In the second technique, variation with time of the glass transition temperature of certain materials can be used to determine the order, rate constant, and activation energy. An application was made to the curing of an epoxy resin. ERA

DATA SUMMARY: Thermal measurements and heat treatments of an epoxy resin performed on a differential scanning calorimeter; variables include time, rate of heat evolution, heat treatment temperature, heat capacity, glass transition temperature, activation energy, and percent cured; 12 figures and 1 table include numeric data.

**N77-19263#** Pennsylvania State Univ., University Park. Materials Research Labs.
**STRUCTURE OF GLASSES CONTAINING TRANSITION METAL IONS Progress Report, 1 Jun. 1975 - 31 Jan. 1976**
S. A. Brawer and W. B. White Feb. 1976 38 p refs
(Contract E(11-1)-2754)
(COO-2754-1) Avail: NTIS HC A03/MF A01

Silicate, borate, and other insulator glasses were prepared and the local structure, interaction with glass structure, influence on nucleation and crystallization, and phase separation of a selected set of transition metal ions was studied. Results are given on the structure of lead silicate and alkaline earth nitrate host glasses as determined by Raman spectroscopy, the role of trivalent and hexavalent chromium in silicate glasses on various compositions, and the luminescence of iron containing glasses. ERA

DATA SUMMARY: Polarized and unpolarized Raman spectra of various glass composition; variables include emission, absorption, frequency, and intensity; 12 figures include numeric data.

**N77-19264#** Purdue Univ., Lafayette, Ind.
**EFFECTS OF INTERNAL GAS PRESSURE AND MICROSTRUCTURE ON THE MECHANISMS OF HOT-PRESSING AND SWELLING IN CERAMICS Progress Report, 1 Jun. 1975 - 31 Mar. 1976**
A. A. Solomon Feb. 1976 18 p refs
(Contract E(11-1)-2713)
(COO-2713-1) Avail: NTIS HC A02/MF A01

Pressurization system components for studying the hot-pressing and swelling behavior of CoO were built. A vacuum furnace was modified so that dimensional changes can be continuously monitored during sintering under high vacuum. Characterization of the CoO starting powders was initiated. A technique was developed to form geometrically uniform pellet compacts of high green density using low pressure punch and die pressing followed by high pressure isostatic compaction to obtain uniform green density. Preliminary sintering experiments were carried out at 1 atm in air, inert gas, and under vacuum with specimen deflection continuously monitored. Resulting microstructures were characterized using mercury porosimetry and quantitative optical microscopy. Drastic differences in sintering rates in vacuum and air were observed. ERA

DATA SUMMARY: Microstructural analysis during sintering of CoO starting powders and pellet formation; the variables include porosity, particle size distribution, temperature effects and gas desorption; 2 figures and 1 table.

**N77-19265#** Baylor Univ., Waco, Tex.
**RADIATION CHEMISTRY OF HIGH POLYMERS Progress Report, 1 May 1975 - 1 May 1976**
Malcolm Dole, Mark E. Land, Vishun M. Patel, Nedeljko Gvozdic, and Robert A. Welch 1 May 1976 12 p refs
(Contract E(40-1)-4059)
(ORO-4059-6; PR-6) Avail: NTIS HC A02/MF A01

A summary of research results obtained in the study of polyethylene irradiation, kinetics of free radical decay in crystalline amino acids, and solubility of H2 and D2 in polyethylene samples of different morphologies is presented. A list of publications and meetings attended is appended. ERA

DATA SUMMARY: Irradiation effects on polyethylene crystals, crystalline amino acids, and hydrogenation of polyethylene samples; the variables include radiation dosage, exposure time, alkyl decay, hydrogen pressure, and sample thickness; 2 figures and no tables.

**N77-19266#** Maryland Univ., College Park. Photomechanics Lab.

**A PHOTOELASTIC CHARACTERIZATION OF DYNAMIC FRACTURE Technical Report, 15 Aug. 1975 - 15 Jul. 1976**

1 Aug. 1976 225 p refs

(Contract AT(49-24)-0172)

(PB-261596/1; NUREG-0072) Avail: NTIS HC A10/MF A01 CSCL 11I

An experimental investigation of the dynamic crack propagation behavior in birefringent polymers (Homalite 100 and modified epoxies) is described. Dynamic, photoelastic, isochromatic, fringe patterns associated with propagating cracks in three different types of Homalite 100 (SEN, DCB and CDCB) specimens, and in SEN specimen for two modified epoxies, were recorded with a highspeed multiple-spark camera. Experimental data are included for several tests for each type of specimen covering cracks propagating from arrest to terminal velocity of approximately 15,500 in/sec (394 m/sec) for Homalite and 13,200 in/sec (335 m/sec) for the epoxies. Methods used for determining the instantaneous values of the stress intensity factor K are described. GRA

DATA SUMMARY: Photoelastic test results on single edge notched, double-cantilevered beam, and contoured double-cantilevered beam specimens of Homalite 100 and epoxies; variables include stress intensity factor, crack velocity, crack tip position, wedge load, crack length, crack opening displacement, deflection, critical strain energy release rate, crack position, time, and material fringe value; 42 figures and 5 tables include numeric data.

**N77-19267#** Rock Island Arsenal, Ill. General Thomas J. Rodman Lab.

**THE LONG-TERM EFFECTIVENESS OF CHEMICAL VS. POLYMERIC ANTIOZONANTS IN RUBBER**

Edward W. Bergstrom Feb. 1976 32 p refs

(DA Proj. 1T1-62105-AH-84)

(AD-A029732; RIA-R-TR-76-027) Avail: NTIS HC A03/MF A01 CSCL 11/10

Chemical and polymeric (EPDM) antiozonants were evaluated in unsaturated elastomers. Vulcanizates inhibited with chemical antiozonants were found to have taken a pronounced set after five years or more of outdoor exposure at Rock Island, Illinois, and exhibited no ozone resistance when restressed and reexposed to ozone. Vulcanizates inhibited with polymeric antiozonants also took a pronounced set in certain cases (depending upon the type of curing system employed), but all peroxide or sulfur-accelerator-peroxide cured vulcanizates retained their ozone resistance when restressed and reexposed to ozone. Polymeric antiozonants have proved to be more effective than the chemical type in those instances where chemical antiozonants function poorly or not at all. When certain unsaturated elastomers are blended with a fast-curing EPDM (FC-EPDM) and a sulfur-accelerator-peroxide-curing system is employed, stress-strain properties equivalent to those of the unsaturated elastomer alone can be obtained. GRA

DATA SUMMARY: Ozone resistance of SBR, NBR, and NR vulcanizates inhibited with chemical antiozonants; variables include compound formulations, stress, time to first crack, elastomer composition, exposure time, percent elongation, and crack free time length; 9 figures include numeric data.

**N77-19268#** Army Engineer Waterways Experiment Station, Vicksburg, Miss.

**LABORATORY AND FIELD EVALUATION OF POLYMERIC CAVITATION EROSION-RESISTANT MATERIALS ON CONCRETE Final Report, May 1960 - Jul. 1973**

Tony B. Husbands and Leonard Pepper Aug. 1976 55 p refs

(AD-A029843; WES-TR-C-76-2) Avail: NTIS HC A04/MF A01 CSCL 11/2

Fifteen polymeric coatings for protecting concrete against cavitation erosion were evaluated. Eight of these materials were found to be cavitation erosion resistant. Five of these eight materials were polyurethane sheet materials: the other three were a liquid-applied polyurethane, a neoprene sheet, and a liquid-applied neoprene. The materials were evaluated by coating mortar specimens with the materials and determining the adhesive bond strength. Those materials which were bonded successfully to the mortar and which showed promise for field application were evaluated further by determining the durability of the bond and the material to water immersion. A nondestructive test method (ultrasonic) was evaluated to determine optimum application of materials in the field. GRA

DATA SUMMARY: Adhesive bond strength and water erosion resistance of plastic coatings for nonmetallic materials; the variables include chloroprene resins, polyurethane resins, corrosion resistance, bonding strength, bond durability, layer thickness, primers, adhesives, tensile strength, tear strength, peel strength, and elongation; 2 figures and 8 tables.

**N77-19269#** Air Force Materials Lab., Wright-Patterson AFB, Ohio.

**ISOTHERMAL DECOMPOSITION STUDIES OF AROMATIC AND AROMATIC-HETEROCYCLIC POLYMERS IN AIR Final Report, Mar. 1971 - Apr. 1974**

Gerhard F. L. Ehlers, Wayne A. Rubey, and Don S. Duvall Jun. 1976 64 p refs

(AF Proj. 7340)

(AD-A029920; AFML-TR-76-93) Avail: NTIS HC A04/MF A01 CSCL 07/3

Ten aromatic and aromatic-heterocyclic polymers were subjected to aging in air at temperatures of 316 C (600 F) and 371 C (700 F) for up to 600 hours, and the volatile decomposition products were determined by gas chromatography. The predominant volatiles by far were carbon dioxide and carbon monoxide being 91 to 99.6% of the total volatiles. Small amounts of water, methane and traces of other aliphatic hydrocarbons were found. Nitrogen containing polymers produced small amounts of nitrogen oxides, cyanogen and hydrogen cyanide, all of which tend to form, and reach a maximum, later than the other volatiles. The volatiles reach their peak concentration only after a certain aging time, roughly related to the thermal stability of the polymers, and ranging between 1/2 and 500 hours at 371 C.

Author (GRA)

DATA SUMMARY: Volatization rate and decomposition product concentrations; the variables include air flow rate, temperature effect, volatization rate, weight loss, volatile concentration, exposure time, and weight of residue; 21 figures and 17 tables.

**N77-19270#** Monsanto Research Corp., Dayton, Ohio.

**FLAME- AND SMOKE-RETARDANT POLYMER SYSTEMS Quarterly Report, May - Jul. 1976**

Leo Parts and Catherine A. Thompson 15 Sep. 1976 46 p refs

(Contract N00024-76-C-5336)

(AD-A030094) Avail: NTIS HC A03/MF A01 CSCL 13/12

The objective of the present program is to evaluate selected means for enhancing the fire performance of two polymeric materials that are widely used on board ship. These materials are molded polyvinyl chloride and Neoprene foam. The means for enhancing fire performance include: (1) catalyzing char formation, (2) reducing the rate of volatile, combustible pyrolyzate formation with intumescent coatings or with ingredients that form insulating glass foams, and (3) catalyzing the oxidation of solid particulate smoke in the vapor phase during flaming combustion. Ferric and cupric acetylacetonate, used together was magnesium carbonate in plasticized PVS, reduced smoke optical density in laboratory tests with a NBS-Aminco chamber 42% to 68% at selected time points. These additives had no adverse effect on the ignitability. The concentrations of the gaseous

combustion products were monitored continuously and simultaneously with smoke. The concentrations of NO sub x HCl and hydrocarbons formed from the flame- and smoke-retardant polymer compositions were generally lower than those observed with the base polymer. The additives enhanced carbon monoxide formation, especially during the later stage of the tests. Means for reducing the extent of oxidation of chars to carbon monoxide will be explored. Author (GRA)

DATA SUMMARY: Concentrations of HCl, HC, CO, CO2, and NOx during burning of PVC compositions; variables include measurement limits, flash ignition temperature, temperature, sample weight, time to maximum concentration, time, and smoke optical density; 6 figures and 21 tables include numeric data.

# 28 PROPELLANTS AND FUELS

Includes rocket propellants, igniters, and oxidizers, storage and handling; and aircraft fuels.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *44 Energy Production and Conversion.*

**N77-19271#** Israeli Program for Scientific Translations Ltd., Jerusalem.

**THERMODYNAMIC AND THERMOPHYSICAL PROPERTIES OF COMBUSTION PRODUCTS. VOLUME 4: NITROGEN TETROXIDE-BASED PROPELLANTS**

V. P. Glushko, ed., V. E. Alemasov, A. F. Dregalin, A. P. Tishin, V. A. Khudyakov, and V. N. Kostin 1976 531 p

(TT-76-50007-Vol-4; ISBN-0-7065-1571-4-Vol-4) Avail: NTIS HC A23/MF A01

The compositions of the group propellants having nitrogen tetroxide as the oxider are calculated. Data on the decomposition of hydrazine and on the properties of the combustion products of the propellant pair N2H4 + B5H0 are included. Basic values, coefficients of extrapolation formulas, and equilibrium composition are presented in tables and graphs. Data are given in calories, the SI system is used, and thermal values are given in joules. Author

**N77-19272*#** Utah Univ., Salt Lake City. Dept. of Civil Engineering.

**MEASURED PROPERTIES OF PROPELLANT FOR SOLID ROCKET BOOSTER OF ONE-EIGHTH SCALE DYNAMIC SHUTTLE MODEL Final Report**

William L. Hufferd Feb. 1972 66 p refs Supersedes UTEC-CE-75-178

(Grant NsG-1113)

(NASA-CR-144938; UTEC-CE-75-178) Avail: NTIS HC A04/MF A01 CSCL 21I

Characterization tests were conducted on the inert solid propellant cast in the 1/8 scale models of the space shuttle. Static and dynamic tests were carried out to evaluate the interconvertibility of static and dynamic response properties according to linear viscoelasticity theory. These tests were carried out at several temperatures and the time (frequency)- temperature superposition principle used to extend the range of applicability of the data. Tests were also conducted to evaluate the effects of moisture (i.e., relative humidity) on propellant response and also the effects of static strain level. A discussion and analysis of the test program and test results are also included. Author

**N77-19273*#** Martin Marietta Aerospace, Denver, Colo.

**SITE ALTERATION EFFECTS FROM ROCKET EXHAUST IMPINGEMENT DURING A SIMULATED VIKING MARS LANDING. PART 2: CHEMICAL AND BIOLOGICAL SITE ALTERATION Final Report**

R. R. Husted, I. D. Smith, and P. V. Fennessey Washington NASA Mar. 1977 51 p refs

(Contract NAS1-9000)

(NASA-CR-2814) Avail: NTIS HC A04/MF A01 CSCL 21I

Chemical and biological alteration of a Mars landing site was investigated experimentally and analytically. The experimental testing was conducted using a specially designed multiple nozzle configuration consisting of 18 small bell nozzles. The chemical test results indicate that an engine using standard hydrazine fuel will contaminate the landing site with ammonia (50-500ppm), nitrogen (5-50ppm), aniline (0.01-0.5ppm), hydrogen cyanide (0.01-0.5ppm), and water. A purified fuel, with impurities (mostly aniline) reduced by a factor of 50-100, limits the amount of hydrogen cyanide and aniline to below detectable limits for the Viking science investigations and leaves the amounts of ammonia, nitrogen, and water in the soil unchanged. The large amounts of ammonia trapped in the soil will make interpretation of the organic analysis investigation results more difficult. The biological tests indicate that the combined effects of plume gases, surface heating, surface erosion, and gas composition resulting from the retrorockets will not interfere with the Viking biology investigation. Author

**N77-19274#** Northwestern Univ., Evanston, Ill. Dept. of Chemical Engineering.

**LIQUID-LIQUID SURFACE IMPACTION Technical Progress Report, 1 Jan. 1976 - 31 Mar. 1976**

S. G. Bankoff 1976 12 p refs

(Contract AT(11-1)-2512)

(NU-2512-8) Avail: NTIS HC A02/MF A01

Vapor explosions from dropping single drops of a liquid onto the surface of a second liquid are discussed. Liquids used include pentane, Freon-22, Woods metal, water, tin, etc. Mechanisms are discussed and proposed new experiments are described. Author (ERA)

**N77-19275#** California Univ., Livermore. Lawrence Livermore Lab.

**SUPPLY AND DEMAND OF FUEL SOURCES FOR AUTOMOBILES**

Carl J. Anderson 11 May 1976 11 p refs Presented at Proc. of Symp. on Alternate Fuel Resources, Santa Maria, Calif., 25-27 Mar. 1976

(Contract W-7405-eng-48)

(UCRL-78066; Conf-760342-1) Avail: NTIS HC A02/MF A01

A review is given of the state of domestic oil depletion in context of projected world oil production. An optimized strategy for dealing with this problem is discussed. The strategy is based on the development of low cost synfuels and preparation for the introduction and utilization of these synfuels; i.e., smaller more efficient cars are needed that can utilize available synfuels. In addition, advanced batteries are required before electricity from coal and/or nuclear energy can be effectively utilized in transportation. Finally, the result of an economic analysis that indicates the nature of optimization of the overall strategy is given. ERA

**N77-19276#** Los Alamos Scientific Lab., N.Mex.

**INSENSITIVE EXPLOSIVE STUDIES USING PHERMEX**

Richard D. Dick 1976 28 p refs Presented at Am. Soc. for Nondestructive Testing Flash X-ray Symp., Houston, Tex., 27-30 Sep. 1976

(Contract W-7405-eng-26)

(LA-UR-76-1425; Conf-760914-1) Avail: NTIS HC A03/MF A01

Flash radiographs were obtained of insensitive explosives (mixtures of TATB explosive and Kel-F binder) of several shapes using the PHERMEX flash X-ray facility. The corner-turning ability of an insensitive explosive, the character of the expanding detonation wave from a spherical initiation, and the characteristics of colliding detonation waves were examined radiographically. A comparison of certain aspects of the corner-turning properties of the insensitive explosive is made with a sensitive explosive (Composition B). Measurements from the radiographs are used to calculate a C-J pressure and a gamma value for the insensitive explosives and these are compared to data from sensitive explosives. ERA

**N77-19277#** Air Force Rocket Propulsion Lab., Edwards AFB, Calif.

**SOLID PROPELLANT AGING STUDIES Technical Report, 1 Nov. 1974 - 30 Jun. 1976**

Robert C. Corley and Cleveland S. Waterman Aug. 1976 33 p refs

(AD-A030335; AFRPL-TR-76-39) Avail: NTIS HC A03/MF A01 CSCL 21/9

Since 1972 AFRPL has been building up an In-House capability for aging solid propellants. By November of 1974 the facilities had expanded to the point where full scale aging of propellants could be performed. A three-year plan for the accelerated aging of 17 different solid propellant formulations was prepared. The aging conditions include elevated temperatures and humidity. Data has been compiled but no analysis of this data has as yet been accomplished. Author (GRA)

**N77-19278#** Bonner and Moore Associates, Inc., Houston, Tex.
**IMPACT OF FUEL PROPERTIES ON JET FUEL AVAILABILITY Final Technical Report, Apr. 1975 - Apr. 1976**
Joseph C. Dickson and Louis P. Karvelas Apr. 1976 110 p ref
(Contract F33615-75-C-2022; AF Proj. 3048)
(AD-A029493; AFAPL-TR-76-7) Avail: NTIS HC A06/MF A01 CSCL 21/4

A study was conducted to analyze the effects that relaxing certain jet fuel specification requirements would have on jet fuel availability from domestic and foreign sources. The primary objective of the study was to determine the most critical specification requirements where relaxation could be expected to have an impact on availability, and to estimate the effects that changes in these critical specifications would have on the refining industry's willingness to offer jet fuel for sale. The principal tool used in this study was a confidential survey of the U.S. Refining Industry. Results based on the adjusted survey data indicate that, for domestically produced kerosene-type jet fuels, increases of 20% could be realized by relaxing Freeze Point and Final Boiling Point; and increases of about 28% could be realized by relaxing Aromatics, Smoke Point, Freeze Point, and Final Boiling Point (FBP). For naphtha-type jet fuels, an increase of 24% for relaxing Freeze Point alone is indicated. GRA

**N77-19279#** Municipal Environmental Research Lab., Cincinnati, Ohio.
**FUEL AND ENERGY PRODUCTION BY BIOCONVERSION OF WASTE MATERIALS: STATE-OF-THE-ART**
Sylvia A. Ware Aug. 1976 78 p refs
(Contract EPA-68-03-0295)
(PB-258499/3; EPA-600/2-76-148) Avail: NTIS HC A05/MF A01 CSCL 21D

A state of the art summary of biological processes for converting waste cellulosic materials (agricultural, municipal and lumbering wastes) to fuels is presented. It indicates the locations and quantities of suitable wastes and discusses the status of the current processing schemes. The processes discussed are: Acid hydrolysis followed by fermentation; enzyme hydrolysis followed by fermentation; anaerobic digestion of manure and municipal solid waste; and, biophotolysis. GRA

**N77-19280#** Ballistic Research Labs., Aberdeen Proving Ground, Md.
**ACOUSTIC THERMOMETRIC MEASUREMENTS OF PROPELLANT GAS TEMPERATURES IN GUNS Final Report**
Edward M. Schmidt, Edward J. Gion, and Donald D. Shear Aug. 1976 29 p refs
(DA Proj. 1W1-61102-AH-43)
(AD-A030359; BRL-1919) Avail: NTIS HC A03/MF A01 CSCL 19/4

A technique is developed which permits propellant gas temperature to be extracted from pressure measurements taken within the gun tube. Basically similar to acoustic thermometry, the wave speed of a signal propagating at the sonic velocity is determined. In this application, the speed of the expansion wave which propagates back up the gun tube following shot ejection is derived from pressure data taken at discrete axial locations within four calibers of the muzzle of a 20mm gun. The propellant gas temperature is calculated from the measured speed of this wave and the equation of state. Author (GRA)

# 31 ENGINEERING (GENERAL)

Includes vacuum technology; control engineering; display engineering; and cryogenics.

**N77-19281*#** General Electric Co., Hampton, Va. Viking Project Support Services.
**A SUMMARY OF SPACECRAFT LOADS DATA FROM FOUR TITAN CENTAUR LAUNCH VEHICLE FLIGHTS Final Report**
George Kachadourian Washington NASA Mar. 1977 89 p refs
(Contract NAS1-9100)
(NASA-CR-2645) Avail: NTIS CSCL 13M

The payloads carried by the first four Titan Centaur Launch Vehicle flights were a Viking Spacecraft Dynamic Simulator, the Helios-A Spacecraft and the the two Viking Spacecraft. Dynamic loads data were gathered by the NASA Viking Project Office from these four flights. These data are summarized and compared with Viking design requirements. Recommendations on design and test requirements for general spacecraft application are presented. Author

**N77-19282#** Brookhaven National Lab., Upton, N.Y.
**UPPER BOUND TO THE PRESSURE IN AN ELEMENTARY VACUUM SYSTEM**
D. Edwards, Jr. 1976 49 p refs Presented at 23d Natl. Vacuum Symp., Chicago, 21-24 Sep. 1976
(Contract E(30-1)-16)
(BNL-21616; Conf-760921-1) Avail: NTIS HC A03/MF A01

A vacuum system consisting of a volume V, a pump S and a surface area A on which there are initially adsorbed n(0) molecules in a first order desorption state is considered and discussed. The essential result is that P/sub max/ = 1.146 x 100,000 A/St torr is expected to provide a reasonably accurate estimate for the value the pressure should be strictly less than t seconds after the pumping has started given that the pressure in the system is due to an adsorbed surface phase. Experimental tests of this relation have been performed and comparisons are made between this result and the pressure measured in an elementary vacuum system. ERA

**N77-19283#** California Univ., Berkeley. Lawrence Berkeley Lab.
**ROCK EXCAVATION BY PULSED ELECTRON BEAMS**
Robert T. Avery, Denis Keefe, Tor L. Brekke, and Iain Finnie Mar. 1976 6 p refs Sponsored in part by NSF
(Contract W-7405-eng-48)
(LBL-4696) Avail: NTIS HC A02/MF A01

When an intense short pulse of megavolt electrons is deposited in a brittle solid, dynamic spalling occurs with removal of material. Experiments were made on several types of hard rock; results are reproducible and well described theoretically. An accelerator with a rapidly pulsed scanning electron beam was designed that could tunnel in hard rock about ten times faster than conventional drill/blast methods. ERA

**N77-19284#** Army Materiel Development And Readiness Command, Alexandria, Va.
**ENGINEERING DESIGN HANDBOOK. METRIC CONVERSION HANDBOOKS, ENGINEERING DRAWING, COMPUTATIONS**
Jul. 1976 148 p refs
(AD-A029902; DARCOM-P-706-470) Avail: NTIS HC A07/MF A01 CSCL 12/1

The general purpose of this handbook is to prepare scientists, engineers, and technicians of the U. S. Army Materiel Development and Readiness Command (DARCOM) for increasing use of the International Systems of Units (SI) or, as it is frequently referred to, the 'metric system'. The specific objectives are to give DARCOM personnel (1) the tools required to convert the units of physical quantities and equations to SI units, (2) the information needed to correctly interpret specifications and documentation using the SI, and (3) the information needed to generate specifications and prepare documentation in SI units. GRA

**N77-19285#** Naval Ship Research and Development Center, Bethesda, Md. Ship Performance Dept.
**HINGE MOMENT REDUCTION FOR THE AG(EH) MAIN STRUT-POD-FOIL ASSEMBLY BY USE OF TRAILING EDGE TABS**
David W. Coder, Richard M. Norton, and Benjamin B. Wisler Jun. 1976 200 p refs
(SF43421704)
(AD-A029984; SPD-332-04) Avail: NTIS HC A09/MF A01 CSCL 13/10

Hydrodynamic loading on a 1/12th scale model of the ag eh main strut-podfoil was experimentally examined at various velocities, depth of hydrofoil submergence, strut-pod pitch angles, and foil angles of attack. The results, which are in agreement with previous experiments, show that the lift center of p taper ratio 0.3, and leading edge sweep angle 0.724 rad or 41.5 deg is located at 70 to 90 percent of the mean geometric chord. Thus, the experimental results could not be compared directly to the empirical two-dimensional theory that was developed since it had been assumed that this lift acted at mischord. GRA

**N77-19286#** Naval Ship Research and Development Center, Bethesda, Md. Ship Performance Dept.
**METHODS FOR CONTROLLING THE SIDEFORCE ON SURFACE-PIERCING HYDROFOIL STRUTS Final Report**
Richard S. Rothblum, Michael F. Jeffers, and Russell P. Smith Jul. 1976 127 p ref
(AD-A029456; SPD-700-01) Avail: NTIS HC A07/MF A01 CSCL 13/10

Possible means of reducing the sideforce due to sideslip angle on a surface-piercing hydrofoil strut were investigated. An experimental program was performed to test the effect on strut sideforce and ventilation characteristics of 50-percent chord trailing edge flaps, midchord spoilers (split flaps), and airbleed (air injection). The effect of fences was tested in combination with the trailing edge flap and airbleed. All systems were found to be effective in reducing or changing sideforce. Airbleed and spoilers reduced the abruptness of transition to the ventilated state under certain circumstances. Power requirements were evaluated for the case of flapped struts. Fences slightly increased drag, and had a smoothing influence on transition between ventilated and unventilated flow states. GRA

# 32 COMMUNICATIONS

Includes land and global communications; communications theory; and optical communications.

For related information see also *04 Aircraft Communications and Navigation* and *17 Spacecraft Communications, Command and Tracking.*

**N77-19287*#** National Scientific Labs., Inc., McLean, Va.
**A REVIEW OF ORGANIZATIONS INFLUENCING RADIO FREQUENCY ALLOCATIONS TO DEEP SPACE RESEARCH**
Aug. 1976 81 p Prepared for JPL
(Contract JPL-954296)
(NASA-CR-149807) Avail: NTIS HC A05/MF A01 CSCL 17B

The charters and functions of various national and international scientific organizations were examined to identify those which have a direct or indirect influence on the allocation of radio frequencies for use in deep space research. Those organizations identified as having the ability to influence frequency allocations are described. A brief description of each organization is provided, and the members who are influential specifically in frequency allocations are listed. The interrelations between the organizations and how they influence allocations are explained. Author

**N77-19288*#** California Inst. of Tech., Pasadena. Antenna Lab.
**BRAGG INTERACTIONS IN PERIODIC MEDIA**
Dwight L. Jaggard Aug. 1976 193 p refs Prepared jointly with JPL, Pasadena, Calif.
(Contract NAS7-100)
(NASA-CR-149805; TR-75) Avail: NTIS HC A09/MF A01 CSCL 20N

The interaction of electromagnetic waves of wavelength lambda with periodic structures of spatial period lambda are studied. The exphasis of the work is on Bragg interactions where lambda approximately equal to 2 lambda/N and the Bragg order N takes on the values 1, 2,.... An extended coupled waves (ECW) theory is developed for the case N greater or equal to 2 and the results of the theory are found to compare favorably with the exact results of Floquet theory. Numerous numerical results are displayed as Brillouin diagrams for the first few Bragg orders. Moreover, explicit expressions for coupling coefficients, bandgap shifts and bandgap widths are derived for singly periodic media. Particular note is taken of phase speeding effects. Author

**N77-19289*#** New Mexico State Univ., Las Cruces.
**ANTENNA EVALUATION STUDY FOR THE SHUTTLE MULTISPECTRAL RADAR, PHASE 1 Final Report**
Edgar L. Coffey, III and Keith R. Carver Dec. 1976 204 p
(Contract NAS9-95469)
(NASA-CR-151232; PA00874) Avail: NTIS HC A10/MF A01 CSCL 17I

Critical parameters of the shuttle multispectral radar antenna (SMRA) which most affect antenna performance were identified. A preliminary methematical model is presented for describing SMRA performance under the influence of various physical and environmental factors which might degrade performance. Because user groups have not agreed on optimum frequencies best suited for the broadest range of application, the study incorporates frequencies ranging from 1.2 to 14.5 GHz, as well as a consideration of incidence angles from near nadir to nearly 50 deg. Author

**N77-19290*#** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
**BIT ERROR RATE MEASUREMENT ABOVE AND BELOW BIT RATE TRACKING THRESHOLD Patent Application**
Herbert S. Kobayashi, Joe Fowler, and William Kurple, Inventors (to NASA) (Lockheed Electronics Co., Houston, Tex.) Filed 2 Mar. 1977 16 p
(Contract NAS9-12200)
(NASA-Case-MSC-12743-1; US-Patent-Appl-SN-765167) Avail: NTIS HC A02/MF A01 CSCL 17B

Bit error rate is measured by sending a pseudorandom noise (PRN) code test signal simulating digital data through digital equipment to be tested. An incoming signal representing the response of the equipment being tested, together with any added noise, is received and tracked by being compared with a locally generated PRN code. Once the locally generated PRN code matches the incoming signal a tracking lock is obtained. The incoming signal is then integrated and compared bit-by-bit against the locally generated PRN code and differences between bits being compared are counted as bit errors. NASA

**N77-19291*#** Hughes Aircraft Co., El Segundo, Calif. Space and Communications Group.
**EXPERIMENT DEFINITION PHASE SHUTTLE LABORATORY, LDRL-10.6 EXPERIMENT. SHUTTLE SORTIE TO GROUND RECEIVER TERMINAL**
F. E. Goodwin, T. A. Nussmeier, L. S. Stokes, and E. J. Vourgourakis 15 Dec. 1976 203 p refs
(Contract NAS5-20018)
(NASA-CR-152454) Avail: NTIS HC A10/MF A01 CSCL 17B

System development and technology are described for a carbon dioxide laser data transmitter capable of transmitting 400 Mbps over a shuttle to ground station link. Author

**N77-19292*#** Comsat Labs., Clarksburg, Md.
**DATA ANALYSIS REPORT ON ATS-F COMSAT MILLIMETER WAVE PROPAGATION EXPERIMENT, PART 1**
Geoffrey Hyde Sep. 1976 159 p refs
(Contract NAS5-21616)
(NASA-CR-152449) Avail: NTIS HC A08/MF A01 CSCL 20N

The 13/18 GHz COMSAT Propagation Experiment (CPE) was performed to measure attenuation caused by hydrometeors along slant paths from transmitting terminals on the ground to the ATS-6 satellite. The effectiveness of site diversity in

overcoming this impairment was also studied. Problems encountered in assembling a valid data base of rain induced attenuation data for statistical analysis are considered. The procedures used to obtain the various statistics are then outlined. The graphs and tables of statistical data for the 15 dual frequency (13 and 18 GHz) site diversity locations are discussed. Cumulative rain rate statistics for the Fayetteville and Boston sites based on point rainfall data collected are presented along with extrapolations of the attenuation and point rainfall data. Author

**N77-19293#** California Univ., Livermore. Lawrence Livermore Lab.
**COMPUTER ANALYSIS OF THE TWIN-WHIP ANTENNA**
G. J. Burke and A. J. Poggio 1 Jun. 1976 29 p refs Sponsored by the Naval Electronics Lab. Center
(Contract W-7405-eng-48)
(UCRL-52080) Avail: NTIS HC A03/MF A01

Computer techniques are used to analyze the twin-whip, high-frequency, HF communication antenna employed by the U.S. Navy. The antenna is considered both on an infinite ground plane and mounted on a bracket. The program NEC, a modification of the AMP program, was used for the analysis and is very briefly described. Several models of the source region are evaluated, and the results are compared with measured input impedances. A model using a transmission line for the feed region is found to give very accurate results. ERA

**N77-19294#** Los Alamos Scientific Lab., N.Mex.
**DESCRIPTION OF MODEL 73 TELEMETRY SYSTEM FOR REPORTING TEMPERATURE AND IDENTIFICATION**
R. E. Bobbett, A. R. Koelle, S. W. Depp, and R. W. Freyman Jun. 1976 11 p refs
(Contract W-7405-eng-36)
(LA-6410-MS) Avail: NTIS HC A02/MF A01

An electronic identification and temperature monitoring system is described. This system, designated Model 73, was designed and fabricated in 1973 to demonstrate the feasibility of implementing a technique which is based on a passive transponder which responds to interrogation by a transmitter operating in the L-band radar frequencies. The functional elements of this successful preprototype system are documented. ERA

**N77-19295#** Fondazione Ugo Bordoni, Rome (Italy).
**METHODOLOGIES OF DELTA MODULATION [ESAME DELLE METODOLOGIE DI MODULAZIONE DELTA]**
Angelo Toscano and William Wolfowicz 14 Apr. 1976 30 p refs In ITALIAN
Avail: NTIS HC A03/MF A01

A review of the various types of delta modulation is presented with regard to definitions, transient response to sinusoidal input, linear modulation, adaptive modulation, continuous syllabic modulation, and modulation with double integration. ESA

**N77-19296#** Fondazione Ugo Bordoni, Rome (Italy). Centro Onde Millimetriche.
**WAVE PROPAGATION IN A CIRCULAR WAVEGUIDE [PROPAGAZIONE IN GUIDA D'ONDA CIRCOLARE]**
G. C. Corazza (Bologna Univ.) and G. Falciasecca 27 Apr. 1976 50 p refs In ITALIAN
Avail: NTIS HC A03/MF A01

The circular waveguide is considered as a means for long distance wave propagation when operating in mode TE 01. The basic equations are discussed with regard to diameter choice and attenuation. The all important question of coupled modes is detailed together with mode degeneracy when bending is present. The increase in attenuation due to deformations at the factory or during laying is analyzed as well as the increase in signal to noise ratio. A simplified model is presented. ESA

**N77-19297#** Fondazione Ugo Bordoni, Rome (Italy). Centro Onde Millimetriche.
**SYSTEMATIC MEASUREMENT OF THE ELECTROMAGNETIC PROPERTIES OF CIRCULAR WAVEGUIDES [MISURE SISTEMATICHE DELLE CARATTERISTICHE E.M. DI GUIDE D'ONDA CIRCOLARI]**
M. Bonaccorsi 21 Apr. 1976 39 p refs In ITALIAN
Avail: NTIS HC A03/MF A01

The electromagnetic measurements performed on various makes of circular waveguides are presented. Although the guides are supposed to be operating in TE 01 mode the various imperfections and curvatures that may be present generate energy transfer by coupling to modes such as TE 02, TE 11, TM 11, and TE 12. These modes were studied in the range from 40 to 60 GHz. A device to displace the short circuit stud with digital position determination is described. The variations in diameter and ellipticity of various makes of circular waveguides were measured. ESA

**N77-19298#** SEMA (Metra International), Paris (France).
**IONOSPHERIC MODELS FOR EVALUATION OF VHF TRACKING METHODS [ETUDE DES MODELES IONOSPHERIQUES POUR L'EVALUATION DES METHODES DE POURSUITE EN VHF]**
Sep. 1976 124 p In FRENCH
(Contract ESOC-721/75-T)
(ESA-CR(P)-874) Avail: NTIS HC A06/MF A01

The software developed for this study is described. It consists of three parts: a ray tracing algorithm for calculating the ionospheric signal propagation, an algorithm for calculating the ionospheric electron density, and an algorithm for calibration of measurements. ESA

**N77-19299#** Centre National d'Etudes Spatiales, Toulouse (France).
**ACQUISITION OF A PN CODE. COMPARISON OF THE OPTIMAL PROCEDURE AND A THRESHOLD SYSTEM. APPLICATION TO THE PERIGEOLE CASE [ACQUISITION D'UN CODE PN. COMPARAISON DU PROCEDE OPTIMAL ET D'UN SYSTEME A SEUIL. APPLICATION AU CAS DE PERIGEOLE]**
Jean Bernard Deloly Sep. 1976 23 p In FRENCH; ENGLISH summary
(CNES-NT-46) Avail: NTIS HC A02/MF A01

The synchronization of a local PN code generated in the receiver with a received PN code mixed with white Gaussian noise is investigated. It is assumed that the receiver has previously synchronized a local clock with the digit clock of the received code. The synchronization characteristics are computed when the synchronization is achieved by comparing an adapted threshold with the result of the correlation of the two codes, and these are compared with the characteristics obtained by achieving the synchronization by optimum method (optimum reception of orthogonal words corresponding to the different delays between the PN codes). Author (ESA)

**N77-19300#** Centre National d'Etudes Spatiales, Toulouse (France).
**ACQUISITION OF AN UNKNOWN FREQUENCY SIGNAL USING A PHASE LOCKED LOOP [ACQUISITION DU SIGNAL DE FREQUENCE INCONNUE A L'AIDE D'UNE BOUCLE D'ASSERVISSEMENT DE PHASE]**
Serge Viale Sep. 1976 139 p In FRENCH; ENGLISH summary
(CNES-NT-49) Avail: NTIS HC A07/MF A01

A detailed analysis is presented of the behavior of a second-order phase-locked loop acquisition device. The acquisition is achieved by linear sweeping of the VCO frequency, the stop-sweeping decision being made by a coherent detection of the input signal amplitude. All theoretical results are confirmed by an experimental study. A set of curves giving the probability of successful acquisition versus the frequency sweeping rate are given for different signal to noise ratio conditions and different values of the false alarm probability. Author (ESA)

**N77-19301#** Centre National d'Etudes Spatiales, Toulouse (France).
**STATISTICAL PROPERTIES OF NONLINEAR COMPONENTS. APPLICATION TO COMPONENTS HAVING ax (TO THE POWER GAMMA)**
Gerard Tarel Nov. 1976 130 p refs In FRENCH; ENGLISH summary
(CNES-NT-55) Avail: NTIS HC A07/MF A01

A theoretical analysis of the behavior of non-linear components having ax (to power gamma) type characteristics in the presence of signal and noise at their input, is presented. The results are applied to determine the performance of classical

non-linear components (limiter, rectifier...). Extrapolation to more sophisticated characteristics is facilitated. Author (ESA)

**N77-19302#** Centre National d'Etudes Spatiales, Toulouse (France).
**DOPPLER MEASUREMENT [MESURE DOPPLER]**
Jean Bernard Deloly Nov. 1976 26 p refs In FRENCH; ENGLISH summary
(CNES-NT-60) Avail: NTIS HC A03/MF A01

The main methods of Doppler shift frequency measurements are described. Their accuracy in signal plus noise configuration is analyzed. Some considerations on Doppler receivers are given. Author (ESA)

**N77-19303#** Southern Methodist Univ., Dallas, Tex. Dept. of Electrical Engineering.
**DETECTION AND ESTIMATION OF SIGNALS IN UNCERTAIN ENVIRONMENTS Final Report**
M. D. Srinath 31 Aug. 1976 19 p refs
(Grant AF-AFOSR-2727-74; AF Proj. 2304A)
(AD-A031256; AFOSR-76-1119TR) Avail: NTIS HC A05/MF A01 CSCL 09/4

In many communication problems, it becomes necessary to simultaneously detect and extract the signal so that these two operations must be jointly optimized in order to improve receiver performance. The receiver structures so obtained are considerably more complicated than conventional receivers and it is not clear that this added complexity results in a significant improvement in receiver performance. This report investigates a specific suboptimal scheme for estimating a signal in the presence of uncertainty regarding its reception. The scheme uses a probabilistic judgement to determine the presence of the signal in the observations. In order to obtain explicit estimation algorithms and to facilitate performance evaluation, a specific problem of signal estimation under uncertainty, namely the tracking of a target in a multi-target multi-sensor environment is considered. Explicit estimation algorithms are developed and the performance of the receiver is evaluated under conditions involving fading media or quantized observations. Author (GRA)

**N77-19304#** Dikewood Industries, Inc., Albuquerque, N. Mex.
**PENETRATION OF ELECTROMAGNETIC PULSES THROUGH LARGER APERTURES IN SHIELDED ENCLOSURES Final Report**
R. Mittra and L. Wilson Pearson May 1976 78 p refs Prepared by Illinois Univ., Urbana-Champaign
(Contract F29601-74-C-0010; DNA Proj. NWED-QAXEB088) (AD-A029516; AFWL-TR-75-95) Avail: NTIS HC A05/MF A01 CSCL 20/14

The results of an initial investigation of the Singularity Expansion Method representation of the electromagnetic coupling through a rectangular aperture in a perfectly conducting sheet are reported. The problem is formulated in terms of the coupled Hallen-type integral equations for the dual problem of a rectangular plate. The integral equations are converted to a system of linear algebraic equations by way of the method of moments with subsectionally constant expansion functions and collocation testing. Several techniques used in minimizing the execution time of the computations are described. Some difficulties in accurately approximating the singularities of the system of integral equations by the singularities of the algebraic system are discussed. These difficulties arise because the subsectionally constant representation for the current cannot adequately represent the correct edge singularities in the currents on the plate. A set of pole trajectories indicative of the trends in pole location for the plate is reported. A listing of the pertinent computer code is provided. GRA

**N77-19305#** Syracuse Univ., N.Y.
**ON TRANSIENT ELECTROMAGNETIC EXCITATION OF A RECTANGULAR CAVITY THROUGH AN APERTURE Final Report**
David K. Cheng and C. A. Chen Jun. 1976 49 p refs Prepared for Dikewood Industries, Inc.
(Contract F29601-74-C-0010; DNA Proj. NWED-QAXEB088) (AD-A030364; DC-TN-7211-1; AFWL-TR-75-91) Avail: NTIS HC A03/MF A01 CSCL 18/6

Induction theorem is used to formulate the problem of transient electromagnetic excitation of a rectangular cavity through an aperture. New variables are introduced to convert the governing second-order differential equation into a set of first-order equations which correspond to normalized state equations. This conversion will result in faster convergence in the numerical solution. Moment method is employed to solve the equations subject to specified boundary conditions. Cavity fields are expressed in terms of subsectional expansion functions with time-dependent coefficients, and external fields are represented as superpositions of plane waves. These fields are properly matched at the aperture. The procedure for evaluating a typical expansion-coefficient vector by singularity-expansion method is outlined. The formulation takes into account the effect of reflections from cavity walls on the aperture field and does not require that the aperture be small.
Author (GRA)

**N77-19306#** Illinois Univ., Urbana-Champaign. Dept. of Computer Science.
**A MICROPROCESSOR-CONTROLLED INTERFACE FOR BURST PROCESSING M.S. Thesis**
Robert Milton Pleva Jul. 1976 70 p refs
(Contract N00014-75-C-0982)
(AD-A030226; UIUCDCS-R-76-812) Avail: NTIS HC A04/MF A01 CSCL 09/2

As part of the research effort investigating the properties and applications of Burst processing, the question of compatibility with the more usual weighted-binary data representations has been considered. The MICROBURST system is a microprocessor-controlled, general-purpose interface system capable of operating in a multichannel Burst environment. System structure, programming details, and support software are discussed. Author (GRA)

**N77-19307#** American Optical Co., Southbridge, Mass.
**ERBIUM LIDAR CLOUD BASE MEASURING SYSTEM Final Report, Jan. 1974 - Jul. 1976**
Joseph Segre Aug. 1976 38 p refs
(Contract F19628-74-C-0150; AF Proj. 6670)
(AD-A031201; AO-623-F; AFGL-TR-76-0177) Avail: NTIS HC A03/MF A01 CSCL 04/1

Results of development and testing of an Erbium Doped Glass Laser Ceilometer are presented and discussed. Various cloud returns, corresponding to differing weather conditions are shown. The rain, snow, or fog detector is discussed.
Author (GRA)

**N77-19308#** Ohio State Univ., Columbus. ElectroScience Lab.
**A TIME DELAY ALGORITHM FOR ADAPTIVE ARRAYS Quarterly Technical Report, 1 Dec. 1975 - 31 Mar. 1976**
C. S. Tsang and R. T. Compton, Jr. Aug. 1976 60 p refs
(Contract N00019-75-C-0179)
(AD-A030588; ESL-4326-1) Avail: NTIS HC A04/MF A01 CSCL 09/4

This report discusses controlled time delays in adaptive arrays. A control algorithm that will either mizimize or minimize array output power is derived and applied to an array with two controllable delays. An example is also given showing how this algorithm can be used for interference rejection. Author (GRA)

**N77-19309#** Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio.
**A NEW MEASURE OF TELEVISION DISPLAY QUALITY RELIABLE TO OBSERVER PERFORMANCE**
H. L. Task and R. W. Verona Aug. 1976 49 p refs
(AF Proj. 7184; AF Proj. 2050)
(AD-A030568; AMRL-TR-76-73) Avail: NTIS HC A03/MF A01 CSCL 09/5

This report describes a new, direct measurement method of determining the imaging quality of cathode-ray tube (CRT), line scan displays. This measurement was specifically developed as a more critical and realistic indicator of display quality. The measurement consists of recording the modulation contrast available on the display as a function of spatial frequency. An electronic sine wave generator produces a sine wave intensity pattern of the face of a CRT display. The display luminance distribution is scanned using a telephotometer or microphotometer depending on the size of the display. The modulation contrast of the display is obtained from the photometer scan for several spatial frequencies. The resulting graph showing modulation versus

frequency is defined as the Sine Wave Response (SWR) Curve of the display. Since human vision is not linearly related to modulation, it is desirable to transform the modulation axis to another parameter which is linearly related to vision. This can theoretically be accomplished by transforming the modulation contrast to square root of 2 incremented Gray Shades. The resulting Gray Shade Response (GSR) indicates how many gray shades are visible as a function of spatial frequency. GRA

**N77-19310#** Naval Research Lab., Washington, D.C.
**VHF-UHF AIRCRAFT ANTENNA Final Report**
Frederick Fine 23 Jul. 1976 33 p
(NRL Proj. R07-35)
(AD-A030894; NRL-8012) Avail: NTIS HC A03/MF A01 CSCL 09/5

A broadband, circularly polarized antenna system suitable for use on WP-3 aircraft and operating in the VHF-UHF frequency region has been designed and fabricated. This airborne radiometer system will operate over a 3 to 1 frequency range without tuning. The installation contains a high- and low-frequency hemispherical coverage antenna and a high- and low-frequency fan-beam array. The entire installation is designed to fit into the standard APS-20 radome of the WP-3. Use has been made of a novel antenna element to achieve good pattern performance in such a confined space. Emphasis has been placed on low loss and reliable operation. Author (GRA)

**N77-19311#** Naval Research Lab., Washington, D.C.
**A CIRCULARLY POLARIZED YAGI ANTENNA SYSTEM FOR NTS-1 AND NTS-2 GROUND STATIONS Final Report**
Louis D. Breetz Sep. 1976 26 p refs
(NRL Proj. R04-16)
(AD-A030969; NRL-MR-3330) Avail: NTIS HC A03/MF A01 CSCL 09/5

A circularly polarized yagi antenna system for use with GPS Navigational Technology Satellites (NTS-1 and NTS-2) ground stations was designed and a model built and tested. The report describes the design philosophy and techniques used, actual constructional dimensions for the model, and calculated and measured performance characteristics. Author (GRA)

**N77-19312#** Ohio State Univ. Research Foundation, Columbus.
**GTD-AMP COMPUTER PROGRAM DESCRIPTION, USER'S MANUAL Technical Report, Oct. 1974 - Dec. 1975**
R. J. Luebbers, R. G. Kouyoumjian, and L. Ton-that Griffiss AFB, N. Y. RADC Feb. 1976 65 p refs
(Contract F30602-75-C-0051; AF Proj. 4506)
(AD-A031108; RADC-TR-76-23) Avail: NTIS HC A04/MF A01 CSCL 09/5

This report describes the capabilities, limitations, and operation of the OSU, GTD-AMP Computer Code, which has been developed to calculate the electromagnetic radiation from currents on thin wires in the presence of a perfectly-conducting polygonal plate positioned over a reflecting surface of infinite extent. Although the code is based on the Geometrical Theory of Diffraction (GTD) it is designed to be compatible with the Antenna Modeling Program (AMP). The GTD-AMP program described herein is capable of handling many antenna-scattering problems once the currents on the wire radiators are known. Ordinarily these currents are found from the AMP program in the manner described in the text; however, they may be specified or obtained by other means. This combination of the moment method and GTD makes it possible to calculate radiation patterns which could not be calculated by either method individually. GRA

**N77-19313#** Rome Air Development Center, Griffiss AFB, N.Y.
**THE EFFECTS OF EXCITATION ERRORS IN NULL-STEERING ANTENNA ARRAYS**
J. McIlvenna, C. Drane, J. Schindler, and R. Mailloux Jun. 1976 93 p refs
(AF Proj. 5635)
(AD-A031153; RADC-TR-76-183) Avail: NTIS HC A05/MF A01 CSCL 09/5

Electronic warfare requirements have spurred the development of antenna design techniques that place nulls in the radiation pattern while simultaneously maximizing some desired performance parameter such as gain or signal-to-noise ratio. Such anti-jam techniques require amplitude and phase control of the antenna elements and, on the surface, seem to offer the possibility of obtaining deep pattern nulls and therefore, cancellation of jamming effects. It is well known however, that excitation errors will fill in the pattern nulls and can also squint the beam and modify the sidelobe levels. In this report, the emphasis is on quantifying the error effects. Starting with techniques for the design of null and deep trough patterns, the effects random, discretization, and accuracy errors in the required amplitude and phase settings are examined. Comparison of three radiation patterns, that is, the error free pattern, the average pattern, and the average plus standard deviation pattern illustrates the null and trough depths actually achievable in the presence of feeding errors. GRA

**N77-19314#** Nebraska Univ., Lincoln.
**EVALUATION OF REMOTE RADIOGRAPHIC COMMUNICATION Final Progress Report, 30 Jun. 1973 - 31 Dec. 1975**
Prentiss Dettmann 22 Jun. 1976 15 p
(Grant HS-01210)
(PB-259622/9; NCHSR-76/432) Avail: NTIS HC A02/MF A01 CSCL 06L

Implementation and evaluation is discussed for a commercially available slow scan television system for transmitting radiographs between the small rural community of Broken Bow, Nebraska, which had no radiologist, and the Department of Radiology at the University of Nebraska. Multiple images were stored on a video disc before being read by the radiologist. This report presents the findings from this project in terms of utilization and equipment effectiveness and reliability. GRA

**N77-19315#** Office of Telecommunications, Boulder, Colo. Inst. for Telecommunication Sciences.
**REFRACTIVITY AND RAINFALL DATA FOR RADIO SYSTEMS ENGINEERING**
C. A. Samson Sep. 1976 166 p refs
(PB-260723/2; OTR-76-105) Avail: NTIS HC A08/MF A01 CSCL 17B

Information on refractivity gradients and rainfall rates is provided for application to the planning and engineering of microwave line-of-sight radio systems. The 100-m refractivity gradients calculated from radiosonde observations at 15 U.S. and 49 foreign stations are presented in the form of graphs of the cumulative probability distribution. As an indication of the diurnal variability of the gradients, separate distributions are shown for each of two daily observations at 29 stations, and for four daily observations at 4 stations. Point rainfall rate distributions, based on recording rain gage statistics, are given for 29 stations in various climatic areas of the world, including 8 locations in the U.S. GRA

**N77-19101*#** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**RADIO FREQUENCY INTERFERENCE FROM NEAR-EARTH SATELLITES**
B. K. Levitt and J. R. Lesh *In its* The Deep Space Network 15 Feb. 1977 p 69-77 ref (For primary document see N77-19091 10-12)
Avail: NTIS HC A13/MF A01 CSCL 17B

**N77-19108*#** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**WALSH TRANSFORMS AND SIGNAL DETECTION**
L. R. Welch *In its* The Deep Space Network 15 Feb. 1977 p 127-131 ref (For primary document see N77-19091 10-12)
Avail: NTIS HC A13/MF A01 CSCL 17B

**N77-19532#** Hamburg Univ. (West Germany). Meteorologisches Inst.
**MAN-MADE MODIFICATION OF CLEAN-AIR PROPAGATION CONDITIONS (VHF TO EHF)**
H. Jeske *In* AGARD Artificial Modification of Propagation Media Jan. 1977 5 p refs (For primary document see N77-19530 10-42)
Avail: NTIS HC A09/MF A01

**N77-19533#** Siemens A.G., Munich (West Germany).
**REVIEW ON COMMUNICATION ASPECTS OF CHAFF-PRODUCED SCATTER PROPAGATION**
E. Lampert *In* AGARD Artificial Modification of Propagation Media Jan. 1977 10 p refs (For primary document see N77-19530 10-42)
Avail: NTIS HC A09/MF A01

**N77-19538#** White Sands Missile Range, N.Mex.
**A REVIEW OF VHF/UHF SCATTERING FROM A HEATED IONOSPHERIC VOLUME**
J. Minkoff and I. Weissman *In* AGARD Artificial Modification of Propagation Media Jan. 1977 21 p refs (For- primary document see N77-19530 10-42)
Avail: NTIS HC A09/MF A01

**N77-19541#** Stanford Univ., Calif. Radioscience Lab.
**MODIFICATION OF THE PROPAGATION CHARACTERISTICS OF THE IONOSPHERE (AND THE MAGNETOSPHERE) BY INJECTION INTO THE MAGNETOSPHERE OF WHISTLER-MODE WAVES**
R. A. Helliwell, J. P. Katsufrakis, and P. A. Bernhardt *In* AGARD Artificial Modification of Propagation Media Jan. 1977 8 p refs (For primary document see N77-19530 10-42)
Avail: NTIS HC A09/MF A01

**N77-19542*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**LOW FREQUENCY ELECTRIC FIELD VARIATIONS DURING HF TRANSMISSIONS ON A MOTHER-DAUGHTER ROCKET**
T. J. Rosenberg (Maryland Univ., College Park), M. C. Maynard, J. A. Holtet, N. O. Karlsen, A. Egeland, T. Moe (Bergen Univ., Norway), and J. Troim (Norwegian Defence Res. Estab., Kjeller) *In* AGARD Artificial Modification of Propagation Media Jan. 1977 11 p refs Sponsored by the Royal Norwegian Council for Scientific and Industrial Res. Prepared in cooperation with Oslo Univ. (For primary document see N77-19530 10-42)
Avail: NTIS HC A09/MF A01

# 33 ELECTRONICS AND ELECTRICAL ENGINEERING

Includes test equipment and maintainability; components, e.g., tunnel diodes and transistors; microminiaturization; and integrated circuitry.

For related information see also *60 Computer Operations and Hardware* and *76 Solid-State Physics*.

**N77-19316*#** Watkins-Johnson Co., Palo Alto, Calif.
**CONTRACT TO DESIGN, FABRICATE AND TEST AN ELECTRON BOMBARDED SEMICONDUCTOR (EBS) DEVICE Quarterly Progress Report**
R. L. Arnold 1976 36 p
(Contract NAS5-20881)
(NASA-CR-152457) Avail: NTIS HC A03/MF A01 CSCL 09C

The characteristics of the low resistivity diode and the double epitaxial style diode are reported. Both met required breakdown voltage and capacitance voltage characteristics. The double epitaxial style diodes are expected to improve target efficiencies. Author

**N77-19317*#** Georgia Inst. of Tech., Atlanta. School of Ceramic Engineering.
**INVESTIGATION OF THE GROWTH OF DIRECTIONALLY SOLIDIFIED EUTECTICS WITH POTENTIAL AS ELECTRON EMITTERS Final Report, 1 Apr. 1975 - 3 Sep. 1976**
A. T. Chapman and J. K. Cochran 4 Oct. 1976 76 p refs (Contracts NAS7-100; JPL-954193)
(NASA-CR-149859; E-18-610) Avail: NTIS HC A05/MF A01 CSCL 09A

The construction of a solar furnace was completed and it was tested after a preliminary alignment of the heliostat mirrors. After final alignment, the solar furnace is used for directional solidification experiments designed to simulate space conditions. Author

**N77-19318*#** Gustincic (J. J.) Consulting Engineer, Marina Del Rey, Calif.
**AN ANTENNA SYSTEM FOR THE MICROWAVE LIMB SOUNDER Final Report**
J. J. Gustincic 1 Oct. 1976 23 p ref Prepared for JPL
(Contracts NAS7-100; JPL-954294)
(NASA-CR-149808; TR-077) Avail: NTIS HC A02/MF A01 CSCL 09C

The results of an initial design study to determine a suitable antenna system for the Microwave Limb Sounder experiment are presented. The resulting antenna system consisting of a parabolic cylinder fed by a number of Gregorian subreflectors is described and estimates of achievable antenna beamwidths and beam efficiencies are made. A short analysis is presented which yields expressions for the subreflector coordinates which can be implemented into existing programs for future antenna design and evaluation. Author

**N77-19319*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**LOGARITHMIC CIRCUIT WITH WIDE DYNAMIC RANGE Patent Application**
Paris H. Wiley (Va. Polytechnic Inst. and State Univ.) and Eugene A. Manus, inventors (to NASA) (Va. Polytechnic Inst. and State Univ.) Filed 16 Feb. 1977 15 p Sponsored by NASA
(NASA-Case-GSC-12145-1; US-Patent-Appl-SN-769149) Avail: NTIS HC A02/MF A01 CSCL 09C

A circuit deriving an output voltage that is proportional to the logarithm of a dc input voltage, and is susceptible to wide variations in amplitude was fabricated. A constant current source which forward biases a diode so that the diode operates in the exponential portion of its voltage versus current characteristic, above its saturation current is included. The constant current source includes first and second, cascaded feedback, dc operational amplifiers connected in a negative feedback circuit. An input terminal of the first amplifier is responsive to the input voltage. A circuit shunting the first amplifier output terminal includes a resistor in series with the diode. The voltage across the resistor is sensed at the input of the second dc operational feedback amplifier. The feedback voltage derived from the output of the second amplifier is subtracted by the first amplifier from the input voltage so that the current flowing through the resistor is proportional to the input voltage. NASA

**N77-19320*#** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
**PHASE ARRAY ANTENNA CONTROL Patent Application**
George D. Doland, inventor (to NASA) (Lockheed Electronics Co., Houston, Tex.) Filed 3 Feb. 1977 51 p
(Contract NAS9-12200)
(NASA-Case-MSC-14939-1; US-Patent-Appl-SN-765165) Avail: NTIS HC A04/MF A01 CSCL 09C

The present invention provides several improvements in steering and control of phased array antennas having a small number of elements, typically on the order of 5 to 17 elements. Among the improvements are increasing the number of beam steering positions, reducing the possibility of phase transients in signals received or transmitted with the antennas, and increasing control and testing capacity with respect to the antennas. Author

**N77-19321*#** Split Univ. (Yugoslavia). School of Electrical Engineering.
**COMPUTER AIDED NONLINEAR ELECTRICAL NETWORKS ANALYSIS**
Peter Slapnicar Washington NASA Mar. 1977 83 p refs (Grant NsG-7163)
(NASA-CR-2810) Avail: NTIS HC A05/MF A01 CSCL 09C

Techniques used in simulating an electrical circuit with nonlinear elements for use in computer-aided circuit analysis programs are described. Elements of the circuit include capacitors, resistors, inductors, transistors, diodes, and voltage and current sources (constant or time varying). Simulation features are discussed for dc, ac, and/or transient circuit analysis. Calculations are based on the model approach of formulating the circuit equations. A particular solution of transient analysis for nonlinear storage elements is described. Author

**N77-19322*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

**A COMPLEMENTARY MOS PROCESS**
Murzban D. Jhabvala Washington Mar. 1977 37 p refs
(NASA-TR-R-470; G-7702F-7) Avail: NTIS HC A03/MF A01 CSCL 09A

The complete sequence used to manufacture complementary metal oxide semiconductor (CMOS) integrated circuits is described. The fixed-gate array concept is presented as a means of obtaining CMOS integrated circuits in a fast and reliable fashion. Examples of CMOS circuits fabricated by both the conventional method and the fixed-gate array method are included. The electrical parameter specifications and characteristics are given along with typical values used to produce CMOS circuits. Temperature-bias stressing data illustrating the thermal stability of devices manufactured by this process are presented. Results of a preliminary study on the radiation sensitivity of circuits manufactured by this process are discussed. Some process modifications are given which have improved the radiation hardness of our CMOS devices. A formula description of the chemicals and gases along with the gas flow rates is also included. Author

**N77-19323#** Rockwell International Corp., Anaheim, Calif. Autonetics Group.
**AQUEOUS DEPOSITION OF PROTECTIVE SYSTEMS FOR ELECTRONIC STRUCTURES**
M. E. Farmer 9 Feb. 1977 7 p refs Presented at Intern. Microelectron. Conf./WEST, Anaheim, Calif., 1-3 Mar. 1977
(X77-152/101) Avail: NTIS HC A02/MF A01

A definition of electronic structures is provided. Functions of the structures are described along with protective systems used to enhance operating life and reliability. B.B.

**N77-19324#** Oak Ridge National Lab., Tenn.
**SF6 BREAKDOWN IN CYLINDRICAL FIELD UNDER dc VOLTAGE**
M. Ermel 1975 16 p refs Transl. into ENGLISH from Elektrotech. Z. A (West Ger.), v. 96, n. 11, 1975 p 505-510 Sponsored by ERDA
(ORNL-tr-4185) Avail: NTIS HC A02/MF A01

Investigations were made in a coaxial cylinder system at high dc-voltages up to 900 kV and at high gas pressures up to 6 bar. The SF6-breakdown-behavior can be classified into three regions according to the following aspects: (1) breakdown after steady corona discharges, (2) validity of the similarity law for the discharge onset voltage, and (3) deviations of the similarity law with a marked polarity effect. Possible explanations are given for the polarity effect and the deviation in region 3. The results can be of importance for a future application of SF6-insulation in HVDC systems. ERA

**N77-19325#** Oak Ridge National Lab., Tenn.
**DIELECTRIC STRENGTH OF SF6 IN ac AND dc INHOMOGENEOUS FIELDS**
Samruay Sangkasaad 1975 18 p refs Transl. into ENGLISH from Elektrotech. Z., A. (Berlin), v. 96, no. 11, 1975 p 515-519 Sponsored by ERDA
(ORNL-TR-4183) Avail: NTIS HC A02/MF A01

The corona threshold behavior and breakdown behavior of SF6 in the inhomogeneous field of a rod-plate geometry was investigated in the pressure range from 0.2 to 6 bar. The measurements were made with dc and 50-Hz ac voltages up to 250 kV peak value. Results showed that corona inception and breakdown voltage not only depend on the gas pressure, but are also strong functions of the inhomogeneity of the field. With a constant electrode separation distance an approximately constant minimum value of the breakdown voltage was observed, which however appeared at different gas pressures, depending on the degree of field inhomogeneity. A relationship for predicting the minimum breakdown voltage is given as function of the electrode separation distance. The spark channels were photographed at different gas pressures and results discussed. Measured and calculated values of the initiation voltages are compared. ERA

**N77-19326#** Bendix Corp., Kansas City, Mo.
**INFRARED BARING OF POSITIVE PHOTORESIST FOR HYBRID MICROCIRCUIT FABRICATION**
L. E. Schantz Aug. 1976 69 p refs
(Contract E(29-1)-613)
(BDX-613-1246) Avail: NTIS HC A04/MF A01

The use of infrared heating to bake Shipley AZ1350 positive photoresist before exposure was investigated as an integral part of a cost-effective hybrid microcircuit photolithographic procedure. The baking parameters which affected the substrate temperature were emitter temperature, conveyor speed, emissivity of the substrate surface, and the amount of air forced through the oven chamber. Individual settings on the emitter temperature and conveyor speed controllers were stable and repeatable; however, the substrate emissivity was dependent upon the thin-film composition and photoresist thickness. When the volume of air forced through the oven remained stable, so did its effect on the substrate temperature. Through manipulation and control of these parameters, consistent prebaking of photoresist-coated substrates was achieved. ERA

**N77-19327#** Sandia Labs., Albuquerque, N.Mex.
**PHOTOLITHOGRAPHY OF SMALL (6 MICROMETERS) MAGNETIC BUBBLE MEMORY CIRCUITS**
Susan P. Palmer May 1976 24 p refs
(Contract AT(29-1)-789)
(SAND-76-0213) Avail: NTIS HC A02/MF A01

A photolithographic technique developed for the fabrication of 6-micrometers magnetic bubble memory circuits is described. Standard photolithographic techniques were found to be inadequate for fabricating microscopic size circuits since unimportant errors in fabricating typical hybrid microcircuits become gross errors in the ultrasmall bubble circuits. This new technique meets the stringent requirements necessary in the fabrication of this particular microcircuit, and can be applied to many photolithographic processes where extremely small size and precision are necessary. ERA

**N77-19328#** Sandia Labs., Albuquerque, N.Mex.
**EFFECTS OF SUBSTRATE TEMPERATURE ON SILICON NITRIDE CRACKING OF BEAM LEAD DEVICES DURING THERMOCOMPRESSION WOBBLE BONDING**
D. W. Bushmire, E. L. Chavez, and M. H. Finley Apr. 1976 20 p refs
(Contract AT(29-1)-789)
(SAND-76-0098) Avail: NTIS HC A02/MF A01

The effects of changes in substrate temperature and force upon nitride cracking during bonding are described. Devices were bonded at 150, 200, and 250 C, and at 250 and 525 gms of force, and the amount of nitride damage in the bonding operation was determined. Neither parameter had large effects in cracking. The pulled strength and failure modes were recorded. Approximately 22 percent of the devices developed silicon nitride cracks over the beams. Total production handling and processing result in 80 to 90 percent of the devices having cracked nitride. Although the sample size is small (63 devices), it does not appear that the cracking is dependent on the substrate temperature over the range used in this evaluation. ERA

**N77-19329#** Sandia Labs., Albuquerque, N.Mex.
**DEVELOPMENT OF A MOUNTING TECHNIQUE FOR QUARTZ RESONATORS USING MICROCIRCUIT INTERCONNECT TECHNOLOGIES**
D. W. Bushmire and E. L. Chavez Mar. 1976 18 p refs
(Contract AT(29-1)-789)
(SAND-76-0112) Avail: NTIS HC A02/MF A01

An interconnect capability for attaching to a tungsten metallized Al2O3 package a mounting clip used to hold small (0.051 mm thick x 6.35 mm in diameter) quartz crystal resonators in a nearly stressfree manner was developed. This mounting chip serves as a mechanical support and an electrical connection to the outside of the package. The mount and its bond to the package must be strong enough to hold the crystal in place through a 1000 g 6 msec shock environment. The bonding techniques considered were ultrasonic, thermocompression, thermosonic, and parallel gap welding. The mounting materials evaluated were gold, gold plated kovar, nickel, elgiloy, paliney, and neyoro G. The gold ribbon was selected as the most suitable material, and the method of attach decided upon was parallel gap welding. ERA

**N77-19330#** California Univ., Livermore. Lawrence Livermore Lab.

**TEMPERATURE TESTS OF HIGH FREQUENCY SLIFER OSCILLATOR, LEA73-2176**

C. C Aaron, Jr. 7 Jun. 1976 14 p refs
(Contract W-7405-eng-48)
(UCID-17152) Avail: NTIS HC A02/MF A01

SLIFER (Short Location Indication by Frequency of Electrical Resonance) systems measure stress wave velocity in solid or liquid materials. They monitor underground nuclear detonations at the Nevada Test Site. A shorted length of coaxial cable is a component in an oscillator's tank circuit. This sensor cable is inductive when less than one-fourth wavelength long at the oscillator's resonant frequency. The stress wave from a detonation crushes and shorts this sensor cable. As the short proceeds, inductance decreases and oscillator frequency increases. Tests were conducted to check their reliability under several conditions: (1) at temperatures from -40 to 60 C; (2) with three sensor cable lengths; (3) with sensor cables shorted or open at the far end; and (4) at two input power voltages. ERA

**N77-19331#** California Univ., Livermore. Lawrence Livermore Lab.

**OPTICAL/X-RAY FRAMING CAMERA TUBE**

Ralph Kalibjian 7 Jul. 1976 8 p refs Presented at 12th Intern. Congr. on High Speed Phot., Toronto, 1-7 Aug. 1976
(Contract W-7405-eng-48)
(UCRL-77738; Conf-760828-1) Avail: NTIS HC A02/MF A01

A type of framing camera tube for either X-ray or optical events is being developed at LLL that should have capabilities of sub-100 psec framing times. The concept of such a camera is based on dissection of an electron-image through a multiple aperture plate in an image converter tube. Each aperture in the plate produces an image frame. By use of synchronized deflection in both the dissector and restorer sections of the tube, the sequentially time-developed images from an aperture are restored to an electron-image frame at the phosphor screen. ERA

**N77-19332#** Sandia Labs., Albuquerque, N.Mex.

**GOLD ALUMINUM INTERCONNECT STABILITY ON THIN FILM HYBRID MICROCIRCUIT SUBSTRATES**

D. W. Bushmire Apr. 1976 8 p refs Presented at Intern. Reliability Phys. Symp., Las Vegas, Nev., 20 Apr. 1976 Sponsored by ERDA
(SAND-76-5286; Conf-760457-1) Avail: NTIS HC A02/MF A01

The effects of gold aluminum intermetallic growth on the stability of interconnects to thin film hybrid microcircuits were studied. Tantalum-nitride-chromium-gold was bonded using 0.031 mm aluminum 1 percent Si wire and 0.031 mm aluminum 1 percent Mg wire. These two wire types were also bonded to substrates metallized with tantalum-nitride titanium-palladium-gold. Also, gold wire (0.025 mm) was bonded to aluminum metallization. These metallization-bond systems were evaluated by subjecting the test specimens to various known temperatures and time environments followed by loop pull tests to destruction, bond shear tests to destruction, and four-point probe electrical resistance measurements. The data show that the electrical resistance increases drastically long before mechanical integrity is degraded. The results of aging gold wire bonding to aluminum metallized substrates are described. ERA

**N77-19333#** Los Alamos Scientific Lab., N.Mex.

**FIELD DISTORTION SWITCH FOR ELECTRICALLY DRIVEN FLYING PLATE EXPERIMENTS**

J. W. Conant, M. T. Lynch, W. W. Patterson, and K. D. Ware Jun. 1976 7 p refs
(Contract W-7405-eng-36)
(LA-6417-MS) Avail: NTIS HC A02/MF A01

The use of a field distortion switch in electrically driven flying plate research is described. The switch can be triggered in a range from 1 to 60 kV with a voltage rise time of 15 to 20 ns. The current quarter period of 2 microseconds remains the same over this voltage range because the electrode geometry is not changed. Dry air is used to bathe the electrodes when operating in the range from 9 to 60 kV. Argon is used in the 1 to 10 kV range. ERA

**N77-19334#** Bendix Corp., Kansas City, Mo.

**ROLLER LAMINATION OF MEDIUM TEMPERATURE FLEX CIRCUITS**

W. G. Peterkort Aug. 1976 20 p refs Revised
(Contract E(29-1)-613)
(BDX-613-1412-Rev) Avail: NTIS HC A02/MF A01

The experimental laminator was modified prior to the study. Kapton coverlay from several vendors was evaluated and process definition was developed for the production of certain flex circuit and base laminate configurations. Production machine specifications were established. ERA

**N77-19335#** California Univ., Livermore. Lawrence Livermore Lab.

**MAXIMIZATION OF ENERGY IN THE OUTPUT OF A LINEAR SYSTEM**

D. G. Dudley 15 Apr. 1976 49 p refs
(Contract W-7405-eng-48)
(UCRL-51887) Avail: NTIS HC A03/MF A01

A time-limited signal which, when passed through a linear system, maximizes the total output energy is considered. Previous work has shown that the solution is given by the eigenfunction associated with the maximum eigenvalue in a Hilbert-Schmidt integral equation. Analytical results are available for the case where the transfer function is a low-pass filter. This work is extended by obtaining a numerical solution to the integral equation which allows results for reasonably general transfer functions. ERA

**N77-19336#** Sandia Labs., Albuquerque, N.Mex.

**CALCULATIONS ON THE STRESS COMPENSATED (SC-CUT) QUARTZ RESONATOR**

E. P. EerNisse 1976 7 p refs Presented at 30th Ann. Frequency Control Symp., Atlantic City, N. J., 2 Jun. 1976 Sponsored by ERDA
(SAND-76-5032; Conf-760614-1) Avail: NTIS HC A02/MF A01

Theoretical calculations were carried out on the doubly-rotated SC-cut quartz resonator. The resonant frequency of this resonator is free from the third-order elastic constant effects of static mechanical stress bias. Calculations show that this stress compensation can be adjusted independently from the temperature compensation during fabrication. Angular tolerances necessary to attain the stress compensation are investigated. The theoretical results are shown to agree quantitatively with recently published thermal shock measurements. General expressions for the SC-cut and AT-cut are provided to allow simple calculation of the frequency shifts due to any static mechanical stress bias. ERA

**N77-19337#** Sandia Labs., Albuquerque, N.Mex.

**ELECTRICAL CONDUCTION MECHANISMS IN THICK FILM RESISTORS**

G. E. Pike and C. H. Seager 1976 13 p refs Presented at Intern. Microelectron. Symp., Vancouver, B. C., Canada, 11 Oct. 1976
(Contract AT(29-1)-789)
(SAND-76-5329; Conf-761004-1) Avail: NTIS HC A02/MF A01

The structural and electrical transport characteristics of several ruthenium based, thick film resistor systems were studied for the purpose of determining the dominant electrical conduction mechanism(s). For the electrical transport properties many different types of measurements were made. However, in this paper only two are mainly discussed: the temperature dependence from 1.2 to 400 K and the electric field dependence from 0 to 30 kV/cm of thick film conductance. Although the chemistry of these resistor systems is varied and complex, it is found that their electrical properties are remarkably similar in many respects. As a function of temperature all resistors studied show a broad conductance maximum at several hundred degrees K and a pronounced conductance decrease at and below 4 K. ERA

**N77-19338#** Goodyear Atomic Corp., Piketon, Ohio.

**CHALLENGE TO THOSE IN INSTRUMENTATION RELATED TO PRODUCTIVITY AND MEASURING POWER USAGE**

H. Steinhauer, Jr. 29 Jun. 1976 19 p refs Presented at Conf. on Productivity Through Instrumentation and Control,

Houston, Tex., 10 Oct. 1976
(Contract E(33-2)-1)
(GAT-E-202; Conf-761007-3) Avail: NTIS HC A02/MF A01

With the development of micro-modules and micro-processors, those in instrumentation are challenged to employ the principles of the Incremental Power Demand Computer (IPDC) to better utilize electric power in many applications. The IPDC was developed at the Portsmouth Gaseous Diffusion Plant in 1959 for measuring 2,000,000 kW demand and to better utilize electric power in the production of enriched uranium. The second generation IPDC measures in and out flow on 26 meters to accurately account for transfer of power through the plant substations from one power system to the other, as well as for the power utilized by the plant. This system also prints out the hourly load on each of the meters and is utilized for calculating the multi-million dollar electric power bill each month. The second generation IPDC uses solid-state components mounted on printed circuit boards for reliability. Pulses from the special pickups in the billing watt-hour meters are used by the IPDC to determine and display accurate plant power usage every six minutes. ERA

**N77-19339#** Sandia Labs., Albuquerque, N.Mex.
**RESISTANCE INCREASES IN GOLD ALUMINUM INTERCONNECTS WITH TIME AND TEMPERATURE**
D. W. Bushmire 1976 9 p refs Presented at the Intern. Microelectronics Symp., Vancouver, B. C., Canada, 11 Oct. 1976
(Contract AT(29-1)-789)
(SAND-76-5721; Conf-761004-3) Avail: NTIS HC A02/MF A01

Aluminum wire was ultrasonically bonded to Cr-Au and TiPd-Au thin film metallization on ceramic substrates. The interconnects were exposed to temperatures from 150 to 300 C and times up to 400 hours. The resistance of the interconnects was measured periodically during the exposure to elevated temperatures. There were significant increases of resistance on both types of metallization. Some measurements indicated electrically open interconnects, but the mechanical strength remained high. ERA

**N77-19340#** Sandia Labs., Albuquerque, N.Mex.
**CHARACTERIZATION OF THE THERMOSONIC WIRE BONDING TECHNIQUE**
D. R. Johnson and E. L. Chavez 1976 8 p refs Presented at Intern. Microelectronics Symp., Vancouver, B. C., Canada, 11 Oct. 1976
(Contract AT(29-1)-789)
(SAND-76-5292; Conf-761004-2) Avail: NTIS HC A02/MF A01

The contribution of the thermosonic bonding technique to solid phase bonds on both thin film metallized substrates and thick film metallized component terminations was evaluated. The experimental materials and procedures, the bonding parameters, and the test results are presented. The thermosonic bonding process is capable of producing fine wire gold bonds to a variety of thin and thick film metallized surfaces. These bonds exhibited excellent metal to metal adherence and high tensile strengths. ERA

**N77-19341#** Brookhaven National Lab., Upton, N.Y.
**LONG DISTANCE BULK POWER TRANSMISSION USING HELIUM-COOLED CABLES**
E. B. Forsyth, J. R. Stewart, and J. A. Williams 1976 10 p refs Presented at Underground Transmission and Distribution Conf., Atlantic City, 27 Sep. 1976
(Contract E(30-1)-16)
(BNL-20250; Conf-760913-1) Avail: NTIS HC A02/MF A01

The technical and economic feasibility of using helium-cooled underground cables for power transmission on a 43 mile-long 345 kV system planned for Long Island and on a 350 mile-long transmission route to connect with an existing 500 kV network in Pennsylvania are examined. The technical considerations, cost analysis, and cost summaries are presented. It is concluded that helium-cooled underground transmission systems are capable of performing the function of EHV and UHV overhead transmission lines. However, the specific costs are higher than the overhead transmission costs by a factor of 3. Consequently, the use of superconducting lines only appears probable in urban and suburban areas of heavily developed regions of the US where overhead lines are undesirable. ERA

**N77-19342#** Centre National d'Etudes Spatiales, Toulouse (France).
**SILVER OXIDE CADMIUM ELECTROCHEMICAL CELLS [CONTRIBUTION A L'ETUDE DE L'ACCUMULATEUR ELECTROCHIMIQUE OXYDE D'ARGENT-CADMIUM]**
Yves Dubois Nov. 1976 76 p refs In FRENCH; ENGLISH summary
(CNES-NT-59) Avail: NTIS HC A05/MF A01

A silver oxide-cadmium cell was studied. Batteries were made and tested in electric space environment simulation. The failure mode was analyzed by various physico-chemical methods. Metallic bridge formation between opposite polarity electrodes was studied. A decrease of the reactive surface of silver and cadmium electrodes by a dissolution process was demonstrated. Author (ESA)

**N77-19343#** Tri-Con Associates, Inc., Cambridge, Mass.
**POST FLIGHT EVALUATION OF ELECTRONIC CIRCUITRY PERFORMANCE Final Report, 1 Oct. 1975 - 30 Jun. 1976**
William B. Huber 30 Jul. 1976 29 p
(Contract F19628-76-C-0076; AF Proj. 6690)
(AD-A031202; C-155; AFGL-TR-76-0169) Avail: NTIS HC A03/MF A01 CSCL 09/3

The objective of this work was to provide support service as required at the prelaunch, launch, assembly or operational area in support of satellite density payloads and provide post flight diagnostic and evaluation of electronic circuit performance. GRA

**N77-19344#** IBM Watson Research Center, Yorktown Heights, N.Y.
**THE PHYSICS OF RELIABILITY OF FUTURE ELECTRONIC DEVICES Final Report, 1 Jun. 1974 - 30 Nov. 1976**
Thomas H. DiStefano and King-Ning Tu Griffiss AFB, N. Y. RADC May 1976 111 p refs
(Contract F19628-74-C-0077; ARPA Order 2180; AF Proj. 5621)
(AD-A028884; RADC-TR-76-160) Avail: NTIS HC A06/MF A01 CSCL 20/12

Among the major reliability problems in semiconductor devices are semiconductor surface defects, dielectric breakdown, interdiffusion across interfaces, and corrosion. In the area of surface defects, the authors have used scanned optical techniques to probe defects and recombination centers on silicon surfaces. Crystallographic defects on silicon surfaces, of the type measured by the scanned optical techniques are known to promote device failure. The problem of dielectric breakdown in SiO2, which is particularly important to the reliability of integrated circuits, was investigated both theoretically and experimentally. Interface reactions were found to be particularly important to the reliability of Schottky barriers. Several classifications of metals have been determined and studied with respect to their behavior in the formation of metal silicide Schottky barrier contacts to silicon. On the basis of the classification of reaction properties, the reaction between the metal and either silicon or SiO2 can be explained and understood. GRA

**N77-19345#** Advanced Metals Research Corp., Bedford, Mass.
**ELECTRON BEAM FABRICATION OF SURFACE ACOUSTIC WAVE TRANSDUCERS Final Report, 1 Jan. - 31 Dec. 1975**
John A. Doherty Sep. 1976 94 p refs
(Contract F19628-75-C-0094; AF Proj. 5653)
(AD-A031154; RADC-TR-76-289) Avail: NTIS HC A05/MF A01 CSCL 09/1

Techniques were developed to utilize an electron beam system to fabricate surface acoustic wave transducers. Transducers were fabricated and the electron exposure process was explored. Electron resist techniques were developed and successfully used. System programming was developed and advanced programming concepts were initiated. Procedures were developed to cover a range of geometrical configurations. GRA

**N77-19346#** City Coll. of the City Univ. of New York. Dept. of Electrical Engineering.

**PLANAR CIRCUITS FOR MICROWAVE TUBES Final Report, Jul. 1974 - Jun. 1976**
Morris Ettenberg Jul. 1976 45 p refs
(Grants DAHC04-74-G-0214; DAHC04-75-G-0176)
(AD-A031145; CCEE-M2; ARO-12106.1-EL) Avail: NTIS HC A03/MF A01 CSCL 09/1

Three variations of the Meander Line have been analyzed using the Fletcher Admittance technique. These are the Stub Loaded, Interline Loaded, and Quadruple Parallel lines. The dispersion characteristics have been calculated by evaluating the determinant of the boundary condition matrix and finding the approximate zero numerically. The interaction impedance has been calculated for the Stub Loaded and Quadruple Parallel lines. Comparisons of calculated and experimental results are presented. GRA

**N77-19347#** Hughes Aircraft Co., Fullerton, Calif.
**RESEARCH LEADING TO TRANSDUCER MASTERS Final Report**
W. J. Gray Aug. 1976 29 p refs
(Contract F19628-75-C-0089)
(AD-A030584; RADC-TR-76-249) Avail: NTIS HC A03/MF A01 CSCL 09/5

10X and 1X negative chrome transducer masters were fabricated using a laser interferometer-controlled image repeater. RADC/ET-furnished magnetic tapes provided the programming for generating the 10X masters. 'Ghost images', caused by minute line width variations, were eliminated by increasing the finger artwork to 10,000X. Rigid cleanliness of facility and processing chemicals is required for successful micrometer line width fabrication. Anti-reflective chrome is superior for both 1X and 10X masters. Author (GRA)

**N77-19348#** Naval Research Lab., Washington, D.C. Electronics Technology Div.
**SOME HIGH POWER MEASUREMENTS OF WRD 750-D24 3 dB HYBRIDS Interim Report**
M. L. Reuss, Jr. Aug. 1976 15 p refs
(NRL Proj. R08-36A)
(AD-A030608; NRL-MR-3350) Avail: NTIS HC A02/MF A01 CSCL 09/5

Three dB hybrids in WRD 750-D24 double ridged waveguide have application in broad band high power components such as switches and matrices. Limited information is available as to peak power handling capability for these components. This report presents additional information as to the high power characteristics for four different 3 dB hybrids. Author (GRA)

**N77-19349#** Naval Civil Engineering Lab., Port Hueneme, Calif.
**HIGH VOLTAGE CABLE SPLICING AND CABLE TERMINATION TECHNIQUES Final Report, Jul. 1974 - Dec. 1975**
David E. Weems Aug. 1976 23 p refs
(YF53534006)
(AD-A030872; CEL-TN-1452) Avail: NTIS HC A02/MF A01 CSCL 09/5

The splicing and termination of underground electrical distribution cable requires that the integrity of cable conductor and insulation be maintained throughout its length. A large number of commercial cable splice and termination kits are available which are claimed to fulfill these requirements. The Civil Engineering Laboratory (CEL) was requested to investigate the suitability of these kits for use at Naval shore facilities. Of special interest were the slip-on cable splice and cable termination for solid dielectric insulated cable. These slip-on devices proved to be the easiest and fastest to install with good reproducibility, and the electrical characteristics were as good as, or better than, the other types of cable splice and cable termination kits tested. Author (GRA)

**N77-19350#** Army Missile Research, Development and Engineering Lab., Redstone Arsenal, Ala. Systems Engineering Directorate.
**MICROPROCESSOR PRINTED CIRCUIT BOARDS FOR DIGITAL PROTOTYPE SYSTEMS**
D. K. Fronek and R. A. Lane 29 Jun. 1976 56 p
(AD-A031203; RC-76-3) Avail: NTIS HC A04/MF A01 CSCL 09/5

During the last year, several 4.5 in. x 6 in. printed circuit boards have been designed and fabricated for general and special purpose use in prototyping digital circuits. Since these designs represent a considerable effort, this report presents a descriptive overview of the various circuits and printed circuit boards. Author (GRA)

**N77-19351#** Bureau of Reclamation, Denver, Colo. Engineering and Research Center.
**LINE STATUS TRANSDUCER**
Umberto Milano Oct. 1976 14 p
(PB-259362/2; REC-ERC-76-17) Avail: NTIS HC A02/MF A01 CSCL 09C

The line status transducer was developed to provide an inexpensive and reliable means of obtaining an indication as to whether an electric power system segment is energized or deenergized. Status information is derived from the voltage sensed across a modified electrical insulator. The insulating qualities of the insulator are unaffected by the addition of the sensor. The transducer can monitor any power system segment operating at or above 13.8 kV (line to line). Included in the report are descriptions of circuit functions, installation, alinement, and evaluation tests. GRA

**N77-19352#** National Bureau of Standards, Washington, D.C. Building Services Section.
**EXPLORATORY STUDY OF GLOWING ELECTRICAL CONNECTIONS Final Report**
William J. Meese and Robert W. Beausoliel Oct. 1976 28 p refs Sponsored in part by HUD
(PB-259641/9; NBSIR-76-1011) Avail: NTIS HC A03/MF A01 CSCL 09A

The extent to which loose electrical connections in residential-type branch circuits have overheated in the laboratory is described with electrical and thermal measures. With loose electrical connections visible glows were observed under laboratory test conditions in nominal 120-volt, 15 and 20 ampere branch circuits with both copper and aluminum wire. Characteristics of the flow condition are differentiated from arcing/sparking as sometimes observed in making or breaking electric circuits. Temperatures over 750F were measured on the break-off tab of receptacles. Metal outlet boxes housing glowing connections in an insulated wall test set-up attained temperatures in excess of 450F. GRA

# 34 FLUID MECHANICS AND HEAT TRANSFER

Includes boundary layers; hydrodynamics; fluidics; mass transfer; and ablation cooling.

For related information see also *02 Aerodynamics* and *77 Thermodynamics and Statistical Physics*.

**N77-19353*** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
**TUBULAR SUBLIMATORY EVAPORATOR HEAT SINK Patent**
Bruce W. Webbon, inventor (to NASA) Issued 15 Feb. 1977 6 p Filed 16 Oct. 1975 Supersedes N76-13599 (14 - 04, p 0471)
(NASA-Case-ARC-10912-1; US-Patent-4,007,601; US-Patent-Appl-SN-623187; US-Patent-Class-62-100; US-Patent-Class-62-121; US-Patent-Class-62-269; US-Patent-Class-62-315) Avail: US Patent Office CSCL 20D

An evaporative refrigerator or cooler comprising a bundle of spaced, porous walled tubes closed at one of their ends and vented to a vacuum at the other end is disclosed. The tube bundle is surrounded by a water jacket having a hot water inlet distribution manifold and a cooled water outlet through a plenum chamber. Hot water is pumped into the jacket to circulate around the tubes, and when this water meets the vacuum existing inside the tubes, it evaporates thereby cooling the water in the jacket. If cooling proceeds to the point where water penetrating or surrounding all or part of the tubes freezes, operation continues with local sublimation of the ice on the tubes while the circulating water attempts to melt the ice. Both sublimation and

evaporation may take place simultaneously in different regions of the device. Official Gazette of the U.S. Patent Office

**N77-19354** Engineering Sciences Data Unit, London (England).
**DYNAMIC VISCOSITY OF CARBON DIOXIDE GAS AND LIQUID**
Sep. 1976 24 p
(ESDU-76021; ISBN-0-85679-158-X) For information on availability of series sub-series, and other individual data items, write NTIS, attn: ESDU, Springfield, Va. 22161. HC E99

Equations and values in S1 units of the dynamic viscosity of carbon dioxide for temperatures between 240K and 1500K and for pressures from 1 to 1000 bar are presented in the form of Tables generated by computer. The variation of the dynamic and kinematic viscosity of carbon dioxide with temperature and pressure along the saturation line is given along with the variation of the dynamic viscosity with temperature and pressure in the single-phase region. The tabulated values were calculated at specific values of temperature and pressure from a single representative equation for the viscosity of liquid and gaseous carbon dioxide as a function of temperature and density. Density values, were calculated from the 1973, IUPAC Formulation for the thermodynamic properties of carbon dioxide. ESDU

**N77-19355#** ARO, Inc., Arnold Air Force Station, Tenn.
**A COMPUTER STUDY OF HYPERSONIC LAMINAR BOUNDARY-LAYER/SHOCK-WAVE INTERACTION USING THE TIME-DEPENDENT COMPRESSIBLE NAVIER-STOKES EQUATIONS**
B. K. Hodge AEDC Sep. 1976 48 p refs Backup document for AIAA Synoptic, "Prediction of Hypersonic Laminar Boundary-Layer/Shock-Wave Interactions", scheduled for publication in AIAA Journal in Jun. 1977
(ARO Proj. V33P-04A; ARO Proj. V33A-08A)
(ARO-VKF-TR-76-64) Avail: NTIS HC A03/MF A01

The results of an investigation of hypersonic laminar boundary layer shock wave interactions using the method of MacCormack to solve the time dependent compressible Navier-Stokes equations are presented. Comparisons of the numerical solutions with experimental data were made to ascertain the validity of the numerical method and to identify regions of anomalous behavior. The algorithm gave good results when applied to hypersonic laminar interactions that caused either small or no separated regions and marginal performance when applied to hypersonic laminar interactions having large regions of separated flow. The extents of the separated regions in interactions having large regions of separated flow were underpredicted when compared with experimental data. The predicted wall heat-transfer rates exhibited the correct qualitative trend but not the experimentally measured quantitative values. Author

**N77-19356*#** Polytechnic Inst. of New York, Farmingdale. Aerodynamics Labs.
**SEPARATING AND TURBULENT BOUNDARY LAYER CALCULATIONS USING POLYNOMIAL INTERPRETATION**
S. G. Rubin and S. Rivera Feb. 1977 31 p refs
(Grant NsG-1244)
(NASA-CR-149871; POLY-M/AE-77-4) Avail: NTIS HC A03/MF A01 CSCL 20D

Higher order numerical methods derived from polynomial spline interpolation or Hermitian differencing are applied to a separating laminar boundary layer, i.e., the Howarth problem, and the turbulent flat plate boundary layer flow. Preliminary results are presented. It is found that accuracy equal to that of conventional second order accurate finite difference methods is achieved with many fewer mesh points and with reduced computer storage and time requirements. Author

**N77-19357#** California Univ., Livermore. Lawrence Livermore Lab.
**ADVECTION-DOMINATED FLOWS, WITH EMPHASIS ON THE CONSEQUENCES OF MASS LUMPING**
Philip M. Gresho, Robert L. Lee, and Robert L. Sani (Ill. Univ., Urbana) Feb. 1976 8 p refs Presented at the 2d Intern. Symp. on Finite Element Methods in Flow Problems, Rappalo, Italy, 14-18 Jun. 1976
(Contract W-7405-eng-48)
(UCRL-77026; Conf-760607-2) Avail: NTIS HC A02/MF A01

By obtaining the approximate solution to the advection-diffusion equation in both one- and two-dimensions, for both purely advective (hyperbolic) and advection-dominate flows, and by comparison to finite difference results, it is demonstrated that the Galerkin finite element method can produce highly accurate results provided that the consistent mass formulation is used. The reasons for the superiority of these results to those using mass lumping are presented. Finally, it is shown that a recommended mass lumping procedure for parabolic isoparametric elements generates completely spurious results for advection-diffusion. ERA

**N77-19358#** California Univ., Livermore. Lawrence Livermore Lab.
**COMPARATIVE STUDY OF CERTAIN FINITE-ELEMENT AND FINITE-DIFFERENCE METHODS IN ADVECTION-DIFFUSION SIMULATIONS**
Robert L. Lee, Philip M. Gresho, and Robert L. Sani (Ill. Univ., Urbana) 15 Mar. 1976 7 p refs Presented at Proc. of 1976 Summer Computer Simulation Conf., Washington, D. C., 12-14 Jul. 1976
(Contract W-7405-eng-48)
(UCRL-77539; Conf-760703-6) Avail: NTIS HC A02/MF A01

The utility of the finite-element Galerkin technique in advection-diffusion flow problems is examined by comparison with several finite-difference schemes in one dimension. The calculations show that for relatively coarse grids, finite-element solutions are either comparable to or significantly better than those obtained from the finite-difference schemes considered. For advection-dominated flows, the superiority of the finite-element technique is attributed to spatial coupling of time-derivative terms inherent in the Galerkin discretization. This procedure, absent from convectional finite-difference schemes, leads to very accurate phase properties for the approximate solution even when coarse grids are used. A two-dimensional analogue of the advection-diffusion problem further illustrates the advantages and accuracy of the finite-element method in conjunction with the use of isoparametric elements. ERA

**N77-19359#** Utah Univ., Salt Lake City.
**TURBULENT DIFFUSION IN LINEAR SHEAR FLOW**
S. K. Kao and J. C. Doran Jan. 1976 13 p refs
(Contract E(11-1)-2455)
(COO-2455-10) Avail: NTIS HC A02/MF A01

An analysis of the characteristics of the eddy diffusivity is made, and the equation for turbulent diffusion in a linear flow is derived. This diffusion equation is solved analytically.
Author (ERA)

**N77-19360#** Oak Ridge National Lab., Tenn. Computer Sciences Div.
**ANALYTICAL SOLUTIONS FOR HEAT CONDUCTION**
S. K. Fraley 1976 5 p Presented at 24 Conf. on Remote Systems Technol., Washington, D. C., 14 Nov. 1976
(Contract W-7405-eng-26)
(CONF-761101-2) Avail: NTIS HC A02/MF A01

Green's functions are found for steady state heat conduction in a composite rectangular parallelepiped (RPP) and in a composite right circular cylinder (RCC) assuming no contact resistance. These Green's functions are then used to provide analytical solutions for arbitrary internal source distributions and surface temperature distributions within the RPP or RCC. ERA

**N77-19361#** California Univ., Livermore. Lawrence Livermore Lab.
**MEASURING SMALL INTERNAL PRESSURES ALONG A TUBE DURING STEADY FLOW**
Henry S. Freynik, Jr. and Gerald R. Dittbenner 20 Apr. 1976 23 p refs Presented at the Meeting of the Soc. for Experimental Stress Analysis, Washington, D. C., 9 - 14 May 1976
(Contract W-7405-eng-48)
(UCRL-77305; Conf-760541-1) Avail: NTIS HC A02/MF A01

A tube that can accurately measure small strains and pressure profiles during flow of non-Newtonian paste explosives was designed and strain gaged. Equiangular rosette strain gages were

installed along the length of a 6-mm-dia, 0.46-m-long thin-walled aluminum tube. The rosettes were oriented in the classical stress gage configuration to measure circumferential stress and hence internal pressure independent of other stresses. The tube was static calibrated on a floating-piston pressure calibrator. Steady flow calibration was accomplished by extruding a viscous Newtonian silicone oil. Inlet pressure ranged from 0.5 to 2.1 MPa (75 tp 300 psi). ERA

**N77-19362#** Addis Translations International, Portola Valley, Calif.
**PROBLEM OF ADIABATIC GAS COMPRESSION UNDER THE ACTION OF A SPHERICAL PISTON**
Ya. M. Kazhdan 1975 16 p refs Transl. into ENGLISH of the preprint no. 89, Moscow, Order-of-Lenin Inst. of Applied Math., Acad. of Scis. of the USSR, 1975 16 p Prepared for Lawrence Livermore Lab., Calif.
(Contract W-7405-eng-48)
(UCRL-Trans-11119) Avail: NTIS HC A02/MF A01

The trajectory of a spherical piston compressing an ideal gas is determined, and the resulting gas flow is investigated. All beta characteristics emerging from the piston converge at the piston's center at the moment of its focusing (t = 0). Gas flow in the vicinity of the center is then investigated at small values of t and on the condition that at a certain time t = t sub 1 less than 0 the piston stopped or slowed down. ERA

**N77-19363#** Applied Physics Lab., Johns Hopkins Univ., Laurel, Md.
**THERMAL STRESS EVALUATION OF THE VIKING RTG HEAT SHIELD**
J. T. Stadter and R. O. Weiss Mar. 1976 38 p refs Sponsored by ERDA
(ANSP-M-12; ERDA/DNRA-3060-12) Avail: NTIS HC A03/MF A01

The study consisted of three parts. In the first phase, the influence of the end cap on the barrel wall stresses was examined by parametrically varying the modulus of elasticity of the contact zone between the end cap and the barrel. The second phase was concerned with stresses occuring as a result of an orbital decay reentry trajectory, and the effects of the magnitude and shape of the axial temperature gradient. The final part of the study was concerned with the circumferentially nonuniform temperature distribution which develops during a side-on stable reentry. The last part includes a comparison of stresses generated for a hexagonal cross section with those generated for a circular cross section. ERA

**N77-19364#** California Univ., Berkeley. Lawrence Berkeley Lab. Materials and Molecular Research Div.
**DISTRIBUTION OF MASS TRANSPORT RATES ALONG PARALLEL PLANE ELECTRODES IN FORCED CONVECTION**
U. Landau Jan. 1976 354 p refs
(Contract W-7405-eng-48)
(LBL-2702) Avail: NTIS HC A16/MF A01

Distribution of ionic mass transport rates along a segmented plate-electrode embedded in the wall of a flow channel was measured by the limiting current technique. Local mass transfer coefficents were determined in the electrodeposition of copper. In the laminar flow region local transport rates are correlated. In turbulent flow, the length of the entrance section is shown to be indepenent. The local turbulent transport rates in the entrance section are represented. Results indicate that the decay of turbulent eddies near a solid wall is proportional to the cube of their distance from it. The exponent on the Re number points towards a St number dependence on sq. root f rather than towards the linear dependence indicated by the Chilton-Colburn analogy Mechanically grooved electrodes, as well as electrodes with random type roughness, yield higher limiting rates than on smooth surfaces. The relative height of the roughness elements to the diffusion layer thickness is the dominant parameter.
Author (ERA)

**N77-19365#** California Univ., Livermore. Lawrence Livermore Lab. Dept. of Mechanical Engineering.
**ONE-DIMENSIONAL MODEL FOR COAXIAL FLOWING STREAMS WITH CONDENSATION**
Steve Andes Mar. 1976 58 p refs
(Contract W-7405-eng-48)
(UCID-17112) Avail: NTIS HC A04/MF A01

An analytical model was developed to identify the basic phenomena present in the high temperature flow (2700 K) of two gaseous coaxial streams. The one-dimensional model potentially has application for design of hardware and test conditions for conducting a laser isotope separation feasibility experiment. The processes of interest are those of coupled flow dynamics, liquid condensation of metal vapors, and gaseous diffusion. The stream tubes may initially consist of pure or combinations of an inert carrier - nitrogen, or metal vapor - uranium. A computer code, LISP (Laser Isotope Separation Program), follows from the model. Output from the LISP code is presented in three test cases. They involved stream differences in velocity up to 90,000 mm/sec and in temperatures of 1100 K. The rate controlling process for the cases cited was found to be diffusion. However, condensation was present. ERA

**N77-19366#** Los Alamos Scientific Lab., N.Mex.
**TWO-DIMENSIONAL HOMOGENEOUS AND HETEROGENEOUS DETONATION WAVE PROPAGATION**
Charles L. Mader and Charles A. Forest Feb. 1976 99 p refs
(Contract W-7405-eng-36)
(LA-6259) Avail: NTIS HC A05/MF A01

The process of detonation propagation of homogeneous explosives along surfaces was studied using resolved reaction zones. Arrhenius rate laws, and two dimensional reactive hydrodynamic calculations. The wave curvature increases with increasing reaction zone thickness. The process of detonation propagation and failure of heterogeneous explosives along surfaces and around corners is analyzed. Decomposition that occurs by shock interactions with density discontinuities is described by a burn rate, determined from the experimentally measured distance of run to detonation as a function of shock pressure. The reactive and nonreactive Hugoniot, and the assumption that the reaction rate derived near the front is applied throughout the flow. ERA

**N77-19367#** Sandia Labs., Albuquerque, N.Mex.
**MODEL OF SHOCK WAVE GROWTH IN THE INITIATION OF EXPLOSIVES**
J. W. Nunziato, J. E. Kennedy, and D. R. Hardesty 1976 41 p refs Presented at 6th Symp. on Detonation, San Diego, Calif., 24 Aug. 1976
(Contract E(29-1)-789)
(SAND-76-5732; Conf-760805-20) Avail: NTIS HC A03/MF A01

The literature on shock initiation has carefully distinguished between the behavior of homogeneous and heterogeneous explosives with regard to reaction ignition, reaction growth, and the modes of wave growth. The differences in shock growth modes in explosives representative of these two classes, nitromethane and PBX-9404, are illustrated through the use of numerical calculations and previously reported experimental data. The observed phenomena are correlated with some basic properties of the recently introduced concept of critical acceleration lambda for shock front growth, which is proportional to the reaction rate, and a new concept called the reaction communication distance, which is defined as the ratio of the sound speed to the reaction rate. As a result, an explanation is provided for such distinctly different growth phenomena as superdetonation in homogeneous explosives and the strong pressure disturbance and growth at the front in heterogeneous explosives. ERA

**N77-19368#** Oak Ridge National Lab., Tenn.
**EXPERIMENTAL STUDY OF FLOW MONITORING INSTRUMENTS IN AIR-WATER, TWO-PHASE DOWNFLOW**
John D. Sheppard, P. H. Hayes, and M. C. Wynn 1976 24 p refs Presented at Specialists Meeting on Transient Two-Phase Flow, Toronto, 3 Aug. 1976 Sponsored by ERDA
(CONF-760810-1) Avail: NTIS HC A02/MF A01

The performance of a turbine meter, target flow meter (drag disk), and a gamma densitometer was studied in air-water, two-phase vertical downflow. Air and water were metered into an 0.0889-m-ID (3.5-in) piping system; air flows ranged from 0.007 to 0.3 cu m/sec (16 to 500 scfm) and water flows ranged from 0.0006 to 0.03 cu m/sec (10 to 500 gpm). The effects of flow rate, quality, flow regime, and flow dispersion on

the mean and fluctuating components of the instrument signals are also studied. Wire screen flow dispersers located at the inlet to the test section had a significant effect on the readings of the drag disk and gamma densitometer, but had little effect on the turbine. Further, when flow dispersers were used, mass flow rates determined from the three instrument readings and a two-velocity, slip flow model showed good agreement with actual mass flow rate over a three-fold range in quality; mass flows determined with the drag disk and densitometer readings assuming homogeneous flow were nearly as accurate. ERA

**N77-19369#** Battelle Pacific Northwest Labs., Richland, Wash.
**PRELIMINARY EVALUATION OF WET/DRY COOLING CONCEPTS FOR POWER PLANTS**
W. V. Loscutoff Jan. 1976 83 p refs
(Contract E(45-1)-1830)
(BNWL-1969) Avail: NTIS HC A05/MF A01

A large number of possible combinations of air and water flow arrangements and sequences are analyzed. The heat tranfer effectiveness of each was established, based on the assumption of constant size of the dry and wet subsystems. The water consumption required to augment a constant-sized dry subsystem for maintaining cooling capability at a dry bulb temperature in excess of the design conditions for the dry system alone was determined. Results are presented which point to a number of significant conclusions relative to the preferred arrangement of the dry and wet subsystems in dry/wet heat rejection systems. The conclusions are based on the assumption that the wet cooling is used only to augment the dry cooling capability and that minimum consumption of water is a primary consideration. ERA

**N77-19370#** Los Alamos Scientific Lab., N.Mex.
**NUMERICAL CALCULATION OF TWO PHASE FLOW IN A SHOCK TUBE**
William C. Rivard, J. R. Travis, and M. D. Torrey 1976 43 p refs Presented at Specialists Meeting on Transient Two-Phase Flow, Toronto, 3 Aug. 1976
(Contract W-7405-eng-36)
(LA-UR-76-917; Conf-760810-2) Avail: NTIS HC A03/MF A01

Numerical calculations of the dynamics of initially saturated water-steam mixtures in a shock tube demonstrate the accuracy and efficiency of a new solution technique for the transient, two-dimensional, two-fluid equations. The dependence of the calculated results on time step and cell size are investigated. The effects of boiling and condensation on the flow physics suggest the merits of basic fluid dynamic measurements for the determination and evaluation of mass exchange models. ERA

**N77-19371#** Sandia Labs., Albuquerque, N.Mex. Heat Transfer and Fluid Mechanics Div.
**THERMAL CONVECTION FROM A LOCALIZED HEAT SOURCE IN DEEP OCEAN SEDIMENTS**
Walter P. Schimmel, Charles E. Hickox, Harry C. Hardee, and P. C. Montoya Apr. 1976 54 p refs
(Contract AT(29-1)-789)
(SAND-76-0121) Avail: NTIS HC A04/MF A01

Heat transfer in deep ocean sediments by both conduction and convection was studied. Models were constructed and the results compared with some experimental studies, including a recent one in the north-central Pacific. In low-permeability sand and ocean bottom sediment, heat transfer is predominantly by conduction; the temperature of a radioactive waste container in these sediments would be approximately the same if pure conduction dominated the process. Not enough is known about containment versus movement of the water in sediment surrounding such a high-temperature cask. ERA

**N77-19372#** Los Alamos Scientific Lab., N.Mex.
**HEAT PIPE NUCLEAR REACTOR FOR SPACE POWER**
Daniel R. Koenig 1976 22 p refs Presented at 11th Intersoc. Energy Conversion Eng. Conf., State Line, Nev., 12-17 Sep. 1976
(Contract W-7405-eng-36)
(LA-UR-76-998; Conf-760906-14) Avail: NTIS HC A02/MF A01

A heat pipe cooled nuclear reactor has been designed to provide 3.2 MW(t) to an out-of-core thermionic conversion system. The reactor is a fast reactor designed to operate at a nominal heat pipe temperature of 1675 K. Each reactor fuel element consists of a hexagonal molybdenum block which is bonded along its axis to one end of a molybdenum, lithium vapor, heat pipe. The block is perforated with an array of longitudinal holes which are loaded with UO2 pellets. The heat pipe transfers heat directly to a string of six thermionic converters which are bonded along the other end of the heat pipe. An assembly of 90 such fuel elements forms a hexagonal core. The core is surrounded by a thermal radiation shield, a thin thermal neutron absorber and a BeO reflector containing boron loaded control drums. ERA

**N77-19373#** Virginia Polytechnic Inst. and State Univ., Blacksburg.
**STABILITY OF SLAG IN TURBULENT MHD BOUNDARY LAYERS**
William S. Saric, Kenell J. Touryan (Sandia Labs. Albuquerque, N. Mex.), and Melvin R. Scott (Sandia Labs., Albuquerque, N. Mex.) 1976 9 p refs Presented at the 9th AIAA Fluid and Plasma Dynamics Conf., San Diego, Calif., 14-16 Jul. 1976
(Contract AT(29-1)-789)
(SAND-76-5717; Conf-760708-3; AIAA-Paper-76-314) Avail: NTIS HC A02/MF A01

The general problem of liquid layer stability is considered in the presence of body forces, and pressure and shear perturbations generated by an external gas flow. In particular, linear stability analyses are applied to a liquid slag layer driven by a turbulent gaseous boundary layer in the presence of electromotive forces in an MHD channel. It is shown that entrainment of slag could occur in subsonic flows but that the slag layer is stable in supersonic flows. Typical curves exhibit disturbance growth rates, phase velocities and disturbance frequencies as functions of liquid Reynolds number and interface shear stress. Within the restrictive assumptions of the analysis, the results show reasonable agreement with available experimental data. ERA

**N77-19374#** Gesellschaft fuer Kernforschung m.b.H., Karlsruhe (West Germany).
**COMPUTER PROGRAM GANESI: DESCRIPTION OF A COMPUTER PROGRAM FOR THE SIMULATION OF UNSTEADY FLOWS IN GAS DISTRIBUTION NETWORKS**
A. Weimann and K. Wanka Jan. 1976 30 p refs In GERMAN; ENGLISH summary
(KFK-PDV-66) Avail: NTIS (US Sales Only) HC A03/MF A01; ERDA Depository Libraries

Models for the simulation of the dynamics of gas distribution networks play an important role for design and control of these processes. The computer program GANESI for the simulation of unsteady flows in gas distribution networks is described. Network modeling, applications and handling of the program are discussed. The validity and efficiency of the program are demonstrated by calculated network examples. ERA

**N77-19375#** Ecole Nationale Superieure de Techniques Avancees, Paris (France).
**TURBULENCE PENETRATION IN A STRATIFIED MEDIUM USING THE J. L. LUMLEY METHOD Ph.D. Thesis - Marseille Univ. [ETUDE, D'APRES LA METHODE DE J. L. LUMLEY, DE LA PENETRATION DE LA TURBULENCE DANS UN MILIEU STRATIFIE]**
J. Siess Feb. 1975 201 p refs In FRENCH
(Rept-048) Avail: NTIS HC A10/MF A01

The behavior of turbulent flow in stratified fluids is considered in regard to the numerical forecasting of the thermocline phenomenon. The closure of the turbulence equations is detailed within the Reynolds Peclet approximation using the Lumley method of invariant modelling. The homogeneous contributions to correlations between velocity or temperature and pressure gradient were obtained. However, as even in the lowest order of anisotropy the method gives too many terms with unknown coefficients, an original method of turbulent transport by Lagrangian modelling was used. ESA

**N77-19376#** Ecole Nationale Superieure de Techniques Avancees, Paris (France).
**NUMERICAL SIMULATION OF CAVITATION BUBBLE**

**COLLAPSE Ph.D. Thesis - Paris Univ. [SIMULATION NUMERIQUE DU COLLAPSE D'UNE BULLE DE CAVITATION]**
M. Lenoir Feb. 1976 134 p refs In FRENCH
(Contracts DRME-73/645; DRME-75/1006)
(Rept-064) Avail: NTIS HC A07/MF A01

A numerical simulation program was developed to investigate cavitation bubble collapse. Vapor bubbles produced by cavitation can disappear when pressure increases. This collapse leads to cavitation erosion and cavitation noise. The main program is based on the Bernoulli and Laplace equations and determines influence coefficients, source densities, velocity, and time development for the collapsing bubble. Graphs representing the shapes of the collapsing bubble as a function of time are presented for empty bubbles near a wall and a free surface, as well as bubbles near a wall with adiabatic compression. ESA

**N77-19377#** Technische Univ., Berlin (West Germany). Inst. fuer Luft- und Raumfahrt.
**SEMI-ANALYTIC CALCULATION OF UNSTEADY TEMPERATURES IN SKIN-WEB JOINTS AT RANDOM DURATION HEATING [SEMI-ANALYTISCHE BERECHNUNG INSTATIONAERER TEMPERATUREN IN HAUT-STEG-VERBINDUNGEN BEI ZEITLICH BELIEBIGER AUFHEIZUNG]**
Christoph Haberland and Frank Koehler 1976 66 p refs In GERMAN Sponsored by Deut. Forschungsgemeinschaft
(ILR-13; ISBN-3-7983-0562-5) Avail: NTIS HC A04/MF A01

A semi-analytic approximation method was formulated to determine the unsteady temperatures in skin-web joints for constant and random duration (also nonlinear) heat fluxes. In calculating the local temperature distribution a difference is made between a short term and long term solution, according to the time step Fourier number. The advantage of semi-analytic methods is the production of memory coefficients, which can be tabulated and used to determine the characteristic temperatures. The method is demonstrated for two extreme geometries. ESA

**N77-19378#** Royal Aircraft Establishment, Bedford (England). Aerodynamics Dept.
**EXPERIMENTAL STUDIES OF THE BOUNDARY LAYER ON A FLAT PLATE AT MACH NUMBERS FROM 2.5 TO 4.5**
D. G. Mabey and W. G. Sawyer London Aeron. Res. Council 1976 100 p refs Supersedes RAE-TR-74127; ARC-36113 (ARC-R/M-3784; RAE-TR-74127; ARC-36113) Avail: NTIS HC A05/MF A01; HMSO £ L6.50; PHI $25.59

An experimental investigation is presented of the turbulent boundary layer on a large, thermally insulated flat plate, in which Mach-number and total-temperature profiles and shear stress at the wall were measured. The tests covered a range of Mach number from 2.5 to 4.5 and a range of Reynolds numbers based on boundary-layer momentum thickness from about 5,000 to 30,000. Skin friction was measured using a floating-element balance; velocity and temperature profiles across the boundary layer were measured using a combined total temperature and pitot probe. The measured velocity profiles were found to be in fairly good agreement with a number of theoretical treatments. Similarly, the measured skin-friction coefficients were fairly well predicted by flat-plate skin-friction laws. The form of the total-temperature profile close to the wall suggests an increase in turbulent Prandtl number as the wall is approached. At all conditions, the wall temperature was found to be higher than would be expected in adiabatic-flow conditions, while there was a substantial deficit of enthalpy flux within the boundary layer. Subsequent tests suggested that this enthalpy deficit should be attributed to small errors in the temperature measured by this particular probe. Author (ESA)

**N77-19379#** Centre National d'Etudes Spatiales, Toulouse (France).
**FAUST PROGRAM HEAT PIPE EXPERIMENT: GENERAL SUMMARY OF FLIGHT RESULTS [EXPERIENCE CALODUCS DU PROGRAMME FAUST. SYNTHESE GENERALE ET RESULTATS EN VOL]**
Francois Galzin Oct. 1976 38 p refs In FRENCH; ENGLISH summary
(CNES-NT-50) Avail: NTIS HC A03/MF A01

A heat pipe experiment is described, which was conducted aboard a sounding rocket in 1974. Three heat pipes were tested in a zero-gravity field for a period of 320 seconds with a phase change material as heat sink. The data from telemetry indicate that two heat pipes performed as predicted. The working of the third one was disturbed by a thermal leakage coming from the sounding rocket. Author (ESA)

**N77-19380#** Centre National d'Etudes Spatiales, Toulouse (France).
**MEASUREMENT OF HEMISPHERICAL EMITTANCE OF A COATING [METHODE DE MESURE DE L'EMITTANCE HEMISPHERIQUE D'UN REVETEMENT]**
Lucien Henninger Oct. 1976 12 p refs In FRENCH; ENGLISH summary
(CNES-NT-53) Avail: NTIS HC A02/MF A01

The principle of total hemispherical infrared emittance measurement of materials and coatings using a calorimetric method is summarized. A test facility based on this principle is described. When thermal losses are taken into account, the total error is estimated to be less than 2 percent over the temperature range 0 to 50 C. Author (ESA)

**N77-19381#** Calspan Corp., Buffalo, N.Y.
**NONLINEAR SMALL-DISTURBANCE EQUATIONS FOR THREE-DIMENSIONAL TRANSONIC FLOW THROUGH A COMPRESSOR BLADE ROW Interim Scientific Report**
William J. Rae Aug. 1976 51 p refs
(Contract F44620-74-C-0059; AF Proj. 9781)
(AD-A031234; CALSPAN-AB-5487-A-1; AFOSR-76-1082TR)
Avail: NTIS HC A04/MF A01 CSCL 20/4

A derivation is given of the nonlinear, small-disturbance equations governing three-dimensional transonic flow through a fan or compressor rotor. These equations represent the counterpart, for turbomachinery flows, of the small-disturbance equations appropriate to an isolated airfoil. Thus, they facilitate the application to turbomachinery flows of the many numerical solution methods developed in recent years for isolated-airfoil problems. Boundary conditions for design and off-design conditions are formulated, at a level of approximation consistent with the small-disturbance field equations. An order-of-magnitude analysis is presented, which reveals the transonic similarity parameters for flow in blade rows of low and high solidity. The validity of a rectilinear transonic shear flow as a representation of the flow through a fan or rotor is also discussed. Author (GRA)

**N77-19382#** Harvard Univ., Cambridge, Mass. Div. of Engineering and Applied Physics.
**REPORTS IN METEOROLOGY AND OCEANOGRAPHY. NUMBER 9: MOMENTUM AND TRANSFER IN A NEUTRAL AND STRATIFIED TURBULENT SHEAR FLOW Progress Report**
G. A. Seaver Jun. 1976 74 p refs
(Contract N00014-67-A-0298-00; NR Proj. 083-201)
(AD-A030897) Avail: NTIS HC A04/MF A01 CSCL 20/4

A fully developed, two dimensional turbulent flow is established in a water channel with a free surface. The unstratified case is first examined in regards to requirements for two dimensionality, steady state, and properties near the free surface with hot film anemometry. The flow is then stratified by injecting saturated salt water at mid depth. Downstream from the salt injector in the test section the properties of the flow are then examined. Cross sections in the center of the channel one foot apart are taken of the mean and streamwise fluctuating velocities as well as the mean density profiles. This information along with the boundary conditions of the stress at the wall and the pressure gradient at the wall are then fed into the numerical program of the first integral of the equations of motion. This yields the momentum and salinity fluxes, as well as the inertial terms and pressure gradient as a function of depth and the local Richardson Number. The salinity flux and Austausch coefficient behave with the expected reciprocal relationship to the Richardson Number. The momentum results do not. The flow exhibits internal regimes in which the dynamics are different. In the lower region of the flow the turbulent momentum flux is negative, $u'$ and $w'$ are either both positive or negative, and the mean gradient steepens in the streamwise direction. Also the

turbulent momentum flux is balanced by the mean advective fluxes. GRA

**N77-19383#** Honeywell, Inc., Minneapolis, Minn. Government and Aeronautical Products Div.
**HYDROFLUIDIC SERVOACTUATOR DEVELOPMENT Final Report, 6 May 1975 - 27 May 1976**
J. Robert Sjolund Sep. 1976 64 p
(Contract DAAJ02-75-C-0035; DA Proj. 1F1-62114-AH-73)
(AD-A030893; GAPD-W0577; USAAMRDL-TR-76-25) Avail: NTIS HC A04/MF A01 CSCL 13/7

This report covers the design and development of a second-generation hydrofluidic servovalve. The objective of the program was to demonstrate the performance of a servoactuator using a hydrofluidic amplifier cascade input stage that replaces the bellows-driven flapper-nozzle valve of a conventional servovalve, a fluidic feedback transducer, and an actuator. The servovalve was designed to interface with a GFE actuator, which was used in the performance of Contract DAAJ02-73-C-0046, and uses U.S. Army aircraft hydraulic fluid meeting specifications of MIL-H-5606. Author (GRA)

**N77-19384#** Ballistic Research Labs., Aberdeen Proving Ground, Md.
**TURBULENT BOUNDARY LAYERS IN BLAST WAVE AND SHOCK TUBE FLOWS Final Report**
Raymond Sedney and Clarence W. Kitchens, Jr. Aug. 1976 71 p refs
(DNA Proj. NWED-QAXNF034)
(AD-A029435; BRL-1907) Avail: NTIS HC A04/MF A01 CSCL 19/4

An unsteady boundary layer is formed along the ground as a result of nuclear explosions and large HE bursts. This boundary layer influences overturning vulnerability predictions for combat vehicles subjected to blast loading. An integral boundary-layer theory is used to predict the growth of the turbulent boundary layer behind a blast wave. Predictions are presented for conventional and nuclear yields ranging from 18,100 kg (20 ton) to 9.07 x 10 to the 8th power kg (1 Mton) TNT equivalent. The boundary-layer growth is calculated using two techniques and compared with experimental boundary-layer measurements taken in a 90,700 kg (100 ton) TNT surface tangent sphere explosion. One of the techniques, based on experimentally-derived values for shock position and velocity appears to give a reasonable estimate of the boundary-layer thickness based on the limited experimental data available for comparison. Shock tube simulation of blast wave boundary-layer effects is discussed. Estimates are presented for the growth of the wall boundary layer in the BRL 2.44m (8 ft) shock tube and the boundary layer that can be formed on a ground plane mounted in this shock tube. Testing in the wall boundary layer is not feasible because of balance response-time restrictions. It appears that blast wave boundary layers of moderate thickness, on the order of a meter or less can be simulated using the shock tube ground plane boundary layer. Author (GRA)

# 35 INSTRUMENTATION AND PHOTOGRAPHY

Includes remote sensors; measuring instruments and gages; detectors; cameras and photographic supplies; and holography.

For aerial photography see *43 Earth Resources*. For related information see also *06 Aircraft Instrumentation*, and *19 Spacecraft Instrumentation*.

**N77-19385*** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
**FLUID MASS SENSOR FOR A ZERO GRAVITY ENVIRONMENT Patent**
G. L. Fogal, inventor (to NASA) (GE Corp., Philadelphia) Issued 2 Nov. 1976 5 p Filed 7 Nov. 1974 Sponsored by NASA
(NASA-Case-MSC-14653-1; US-Patent-3,988,933; US-Patent-Appl-SN-521816; US-Patent-Class-73-432R; US-Patent-Class-177-1; US-Patent-Class-177-208) Avail: US Patent Office CSCL 14B

A sensor for measuring the mass of fluids, is described which includes a housing having an inlet and outlet for receiving and dumping the fluid, a rotary impeller within the housing for imparting centrifugal motion to the fluid and a pressure sensitive transducer attached to the housing to sense the rotating fluid pressure. The fluid may be drawn into the housing by entrainment within a gas stream. The resulting mixture is then separated into two phases: gas and liquid. The gas is removed from the housing and the pressure of the liquid, under centrifugal motion, is sensed and correlated with the mass of the fluid.
Official Gazette of the U.S. Patent Office

**N77-19386*#** Hughes Research Labs., Malibu, Calif.
**ROTATING GRAVITY GRADIOMETER STUDY Final Report, Aug. 1975 - Jun. 1976**
Robert L. Forward 30 Jun. 1976 174 p refs
(Contract NAS7-100; JPL-954309)
(NASA-CR-149800) Avail: NTIS HC A08/MF A01 CSCL 14B

The application of a Rotating Gravity Gradiometer (RGG) system on board a Lunar Polar Orbiter (LPO) for the measurement of the Lunar gravity field was investigated. A data collection simulation study shows that a gradiometer will give significantly better gravity data than a doppler tracking system for the altitudes under consideration for the LOP, that the present demonstrated sensitivity of the RGG is adequate for measurement of the Lunar gravity gradient field, and that a single RGG instrument will provide almost as much data for geophysical interpretation as an orthogonal three axis RGG system. An engineering study of the RGG sensor/LPO spacecraft interface characteristics shows that the RGG systems under consideration are compatible with the present models of the LPO spacecraft. Author

**N77-19387*#** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
**SIGNAL-TO-NOISE RATIO ANALYSIS AND EVALUATION OF THE HADAMARD IMAGING TECHNIQUE**
Daniel J. Jobson, Stephen J. Katzberg, and Robert B. Spiers, Jr. Washington Mar. 1977 32 p refs
(NASA-TN-D-8377; L-11042) Avail: NTIS HC A03/MF A01 CSCL 20F

The signal-to-noise ratio performance of the Hadamard imaging technique is analyzed and an experimental evaluation of a laboratory Hadamard imager is presented. A comparison between the performances of Hadamard and conventional imaging techniques shows that the Hadamard technique is superior only when the imaging objective lens is required to have an effective F (focus) number of about 2 or slower. Author

**N77-19388*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
**OPTICALLY SELECTIVE, ACOUSTICALLY RESONANT GAS DETECTING TRANSDUCER Patent Application**
John Dimeff, inventor (to NASA) Filed 22 Dec. 1975 14 p
(NASA-Case-ARC-10639-1; US-Patent-Appl-SN-643043) Avail: NTIS HC A02/MF A01 CSCL 14B

A gas analyzer is disclosed which responds to the resonant absorption or emission spectrum of a specific gas by producing an acoustic resonance in a chamber containing a sample of the gas. The device measures the amount of emission or absorption by measuring the strength of the acoustic resonance, e.g., the maximum periodic pressure, velocity or density achieved. In the preferred embodiment, a light beam is modulated periodically at the acoustical resonance frequency of a closed chamber which contains an optically dense sample of the gas of interest. Periodic heating of the gas by the light beam causes a cyclic expansion, movement, and pressure within the gas. The amplitude of the excursions increases until an amplitude is reached where the increased losses involving the amplified motions, compressions and thermal cycles are just sufficient to account for the cyclic radiation energy received through the window. A differential pressure converts the pressure variations of the resonant gas into electronic readout signals. NASA

**N77-19389*#** American Science and Engineering, Inc., Cambridge, Mass.
**HIGH RESOLUTION OZONE MAPPER (HROM) Final Report**

**Apr. 1975 - May 1976**
J. R. Kohr, J. Decker, and R. Wegant May 1976 115 p refs (Contract NAS5-22326)
(NASA-CR-152452; ASE-3935) Avail: NTIS HC A06/MF A01 CSCL 14B

Using the backscatter ultraviolet instrument (BUV) aboard NIMBUS 4 as a baseline, point scanner mechanisms and spatial multiplex scanning systems were compared on the basis of sensitivity, field of view and simplicity. This comparison included both spectral and spatial scanning and multiplexing techniques. The selected system which optimally met the performance requirements for a shuttle based instrument was a pushbroom spatial scanner using a 15 element photomultiplier tube array and a Hadamard multiplex spectral scan. The selected system was conceptually designed. This design includes ray traces of the monochromator, mechanical layouts and the electronic block diagram. Author

**N77-19390*#** National Aeronautics and Space Administration. Pasadena Office, Calif.
**PASSIVE INTRUSION DETECTION SYSTEM Patent Application**
Eric G. Laue, inventor (to NASA) (JPL) Filed 9 Feb. 1977 12 p
(Contract NAS7-100)
(NASA-Case-NPO-13804-1; US-Patent-Appl-SN-766999) Avail: NTIS HC A02/MF A01 CSCL 14B

An intrusion detection system is disclosed in which crystal oscillators are used to provide a frequency which varies as a function of fluctuations of a particular environmental property of the atmosphere, e.g., humidity, in the protected volume. The system is based on the discovery that the frequency of an oscillator whose crystal is humidity sensitive varies within a known frequency band if an intruder enters the protected volume. The variable frequency is converted into a voltage which is then filtered by a method which permits only voltage variations at frequencies within the known frequency band to activated an alarm. The system inhibits alarm activation when the voltage frequency is below or above the known frequency band. Author

**N77-19391#** Rockwell International Corp., Anaheim, Calif. Autonetics Group.
**BUBBLE MEMORY SYSTEM APPLICATIONS**
William C. Mavity 28 Feb. 1977 7 p refs Presented at Intern. Electron. Conv., New York, 19-21 Apr. 1977
(X77-209/001) Avail: NTIS HC A02/MF A01

The applications for a small 1 million bit bubble memory recorder were found to be wide and varied and encompassing a broad range of industrial and government users. Simple event recorders, data terminal storage, and microcomputer operating mass memories are among the projects utilizing the bubble technology. In addition to discussing those applications already underway, development trends for future bubble systems are presented. Author

**N77-19392#** Argonne National Lab., Ill.
**IMPROVED TV-SCANNING METHOD FOR RECORDING TIME-RESOLVED OPTICAL SPECTRA OF TRANSIENTS**
K. H. Schmidt, S. Gordon, and W. A. Mulac Mar. 1976 27 p refs
(Contract W-31-109-eng-38)
(ANL-75-62) Avail: NTIS HC A03/MF A01

An improved method to record a time-resolved transient absorption or emission spectrum produced by a single pulse of radiation is described. A streak image of the spectrum is produced by an image-converter camera. The image is scanned by a TV camera, stored in a video-disk recorder, and transferred line by line to a computer. The computer can produce three-dimensional plots of absorbance or emission versus time and wavelength containing 100 x 100 data points. ERA

**N77-19393#** Los Alamos Scientific Lab., N.Mex.
**NEW ELECTRONIC GAIN DEVICE FOR HIGH TEMPERATURE APPLICATIONS**
J. Byron McCormick, Steven W. Depp, Douglas J. Hamilton (Arizona Univ., Tucson), and W. J. Kerwin (Arizona Univ., Tucson) Apr. 1976 9 p refs
(Contract W-7405-eng-36)
(LA-6339-MS) Avail: NTIS HC A02/MF A01

An integrated thermionic device capable of withstanding ambient temperatures in excess of 500 C is described. The history of the ITC (Integrated Thermionic Circuit) is traced along with Los Alamos Scientific Laboratory (LASL) interests for geothermal instrumentation. The evolution of the new structure is discussed and a set of practical device design and performance equations are demonstrated. ERA

**N77-19394#** Los Alamos Scientific Lab., N.Mex.
**SUB-PICOSECOND PROXIMITY-FOCUSED STREAK CAMERA FOR X-RAY AND VISIBLE LIGHT**
A. J. Lieber, H. D. Sutphin, and C. B. Webb 1976 7 p refs Presented at the 20th Ann. SPIE Tech. Symp., San Diego, Calif., 23-27 Aug. 1976
(Contract W-7405-eng-36)
(LA-UR-76-1600; Conf-760832-2) Avail: NTIS HC A02/MF A01

Laser fusion requires diagnostics of high density, high temperature plasmas on the picosecond time scale. To this end a proximity-focused streak camera was under development. An X-ray version of this device was constructed and tested using X-rays generated by irradiating microballoon targets with a two-beam Nd:glass laser. Results indicate the prototype to be of high sensitivity with temporal resolution of 2.5 to 3 ps. Later production cameras based upon this design are expected to give subpicosecond temporal resolution for both X-ray and visible light. The camera is simple, compact, rugged and vacuum compatible. It has proved 98 percent reliable in over 350 laser shots. Applications to other disciplines are being studied and will be discussed. ERA

**N77-19395#** Los Alamos Scientific Lab., N.Mex.
**DESIGN OF X-RAY MICROSCOPES FOR LASER-FUSION APPLICATIONS**
Gene H. McCall 1976 6 p refs Presented at the 20th Ann. SPIE Tech. Symp., San Diego, Calif., 23-27 Aug. 1976
(Contract W-7405-eng-36)
(LA-UR-76-1680; Conf-760832-1) Avail: NTIS HC A02/MF A01

Design techniques for Wolter grazing incidence X-ray microscopes are discussed, and considerations applicable to diamond point micromachining fabrication are described. Also preliminary results of tests on a micromachined mandrel replicated system are presented. ERA

**N77-19396#** Los Alamos Scientific Lab., N.Mex.
**SUB-PICOSECOND X-RAY STREAK CAMERA DEVELOPMENT FOR LASER FUSION DIAGNOSTICS**
A. J. Lieber, H. D. Sutphin, C. B. Webb, and A. H. Williams 1976 7 p refs Presented at the 12th Intern. Congr. on High Speed Phot., Toronto, Can., 1-7 Aug. 1976
(Contract W-7405-eng-36)
(LA-UR-76-1458; Conf-760828-3) Avail: NTIS HC A02/MF A01

In laser-fusion interactions the effectiveness of coupling laser energy into target compression can be followed by obtaining spatial and temporal information on X-radiation emitted by the target. Microballoon targets now used require temporal resolution of better than a few picoseconds to track accurately target collapse and disassembly. Instabilities of two picoseconds or less are predicted for the process. Most streak cameras are based upon a sector-focused streak tube which in the design limit is capable of only about 10 ps X-ray resolution. Therefore, a new tube, based upon the proximity-focused or wafer intensifier was developed as a laser-fusion diagnostic capable in the design limit of delivering truly subpicosecond X-ray resolution. A new power supply was also developed to drive the streak tube. Together, a camera has resulted with true picosecond capability, small size, high sensitivity, broad dynamic range, high spatial resolution, and very low jitter. ERA

**N77-19397#** California Univ., Berkeley. Lawrence Berkeley Lab. Lab. of Chemical Biodynamics.
**INTERFACE FOR ROUTINE SPECTRAL DISPLAY FROM SEVERAL LIQUID SCINTILLATION COUNTERS**
B. E. Gordon, M. Press, W. Erwin, and R. M. Lemmon Apr. 1976 16 p refs Presented at Intern. Conf. on Liquid Scintillation

Sci. and Technol., Banff, Alberta, Canada, 14 Jun. 1976
(Contract W-7405-eng-48)
(LBL-4832; Conf-760640-3) Avail: NTIS HC A02/MF A01

An interfacing circuit for coupling several Tri-Carb liquid scintillation counters to a multichannel analyzer is described. The display of the analyzer is completely controlled from the liquid scintillation counters and information from any of the three channels in each counter can be displayed. The system is being used for both instructional and diagnostic purposes. For the former it will be part of a course on the theory and use of liquid scintillation counting. For the latter it assists in setting up optimum counting conditions for single and double labels in new cocktails as well as for new labels, and to help diagnose counting problems such as chemi- and/or photoluminescence. ERA

**N77-19398#** Brookhaven National Lab., Upton, N.Y.
**LOW LEVEL ENVIRONMENTAL RADIATION MEASUREMENTS WITH A PLASTIC SCINTILLATION DETECTOR SYSTEM**
A. P. Hull and G. S. Levine 1976 5 p refs Presented at NBS Symp. on Meas. for the Safe use of Radiation, Gaithersburg, Md., 1 Mar. 1976
(Contract E(30-1)-16)
(BNL-21123; Conf-760301-4) Avail: NTIS HC A02/MF A01

A plastic scintillation detector-photomultiplier combination, operated in the current mode, has been developed for the measurement of radiation. Its output is digitized and processed by semiconductor circuits, which also provide for hourly compensation of variation in gain utilizing a built-in calibration source. The instrument has been tested in the field for the past two years to establish its response capability to diurnal and longer term variation in background radiation, as well as small increments produced by a distance gamma field irradiation source. ERA

**N77-19399#** Bendix Corp., Kansas City, Mo.
**DUAL CHANNEL MIXER**
J. W. Cable Aug. 1976 19 p refs
(Contract E(29-1)-613)
(BDX-613-1282) Avail: NTIS HC A02/MF A01

A precise vector voltmeter (Princeton Applied Research Model 129, operated in the two-phase lock-in amplifier model) is used in a microwave power calibrating system to accurately measure the outputs of a network analyzer (Hewlett Packard Model 8410 with Model 8411A harmonic frequency converter and Model 8413A phase-gain indicator). The validity of the measured outputs depends on the accurate representation of the network analyzer output (278 kHz) at a lower frequency (20 kHz) with sufficient signal level for proper operation of the vector voltmeter. A dual-channel mixer was constructed to convert 278 kHz to 20 kHz without loading the output ports of the network analyzer or local oscillators. In addition to being properly matched to the remaining circuitry, the mixers are driven in their linear region. ERA

**N77-19400#** Los Alamos Scientific Lab., N.Mex.
**SIMPLE STEP-AND-REPEAT PRECISION COPY CAMERA**
B. Brixner and M. Christian 1976 5 p refs Presented at Photo-Optical Instrumentation Engineers Meeting, San Jose, Calif., 1 Jun. 1976
(Contract W-7405-eng-36)
(LA-UR-76-1072; Conf-760630-1) Avail: NTIS HC A02/MF A01

The copy camera resolves 320 lines/mm on high-resolution film with less than 0.01-mm distortion throughout a 30-mm-diameter image made at 20 : 1 reduction in white or green light. This performance is the result of five special features: (1) an f/4 precision copy lens, which makes diffraction-limited images throughout the image fields; (2) a precision focusing mount, (3) a pressure plate that maintains sharp foc for step-and-repeat exposures, (4) a simple indexing jig that locates the images precisely on 101.6-by 127.0-mm film; and (5) a film holder with registration pins to position the prepunched film precisely in relation to the image positions. The camera is used routinely to make single- and stepped-image photofabrication masks, high-contrast resolution test charts, and special reticles. ERA

**N77-19401#** Massachusetts Inst. of Tech., Oak Ridge, Tenn. School of Chemical Engineering Practice.
**EVALUATION OF AEROSOL GENERATION AND COUNTING TECHNIQUES**
S. L. Michaels and J. P. DAcierno 24 Mar. 1976 33 p refs Sponsored by ERDA
(ORNL/MIT-228) Avail: NTIS HC A03/MF A01

A Royco Model 220 Aerosol Particle Monitor was obtained. The monitor size classifications were calibrated with monodisperse aerosols of known particle diameters generated from monodisperse polystyrene latexes. The number counts shown by the monitor were verified by counting aerosol samples under an optical microscope. The impaction efficiency of the aerosol separator was then measured with the calibrated particle monitor and was found to be within the range predicted by Ranz. ERA

**N77-19402#** Los Alamos Scientific Lab., N.Mex.
**THERMAL STRESS ANALYSIS OF TUNGSTEN COLLIMATORS HEATED BY HIGH-ENERGY PROTON BEAMS**
R. W. Meier and K. H. Duerre Mar. 1976 15 p refs
(Contract W-7405-eng-36)
(LA-6291-MS) Avail: NTIS HC A02/MF A01

An analytical and numerical investigation of the effect of a large quantity of high-energy protons on a tungsten alloy collimator is presented. Three different modes of failure are analyzed: thermal stress, thermal shock, and temperature in excess of the maximum allowable. Three analyses are developed to study the first beam pulse at 1-mA beam current. A quasi-steady-state analysis is applied to study the effect of multiple beam pulses at 0.1-mA beam current. The results for a 1-mA beam indicate that the yield stress is exceeded after 200 microns, but the ultimate stress is not reached during the first beam pulse. The analytical solution is found to give good results in the elastic range. The numerical solution for 0.1-mA beam current shows that the yield stress is reached after 0.23 s and the ultimate stress is exceeded after 0.48 s. ERA

**N77-19403#** Oak Ridge Y-12 Plant, Tenn.
**STRAIN MONITOR SYSTEM FOR THE THREADED CLOSURE ON A THIRTY-INCH PRESSURE VESSEL**
S. L. Chapman, J. A. Kowalewski, and C. R. Olmstead Jun. 1976 52 p refs.
(Contract W-7405-eng-26)
(Y-2040) Avail: NTIS HC A04/MF A01

A system was designed and fabricated to remotely measure and automatically print voltages proportional to strains experienced by the internal threaded areas of the closure on a 30-in. pressure vessel in the Oak Ridge Y-12 Plant. This system was designed to provide continuous monitoring during pressure vessel use and thereby provide a faster response to possible vessel failure, should the data indicate a weakening of the pressure vessel closure. Standard 120-ohm foil strain gages in a wheatstone-bridge configuration are utilized with an integrated circuit instrumentation amplifier and multiplexing logic installed within the vessel closure to minimize the wiring problems. The system has performed satisfactorily and has provided data on 15 gages located within the closure. ERA

**N77-19404#** Oak Ridge National Lab., Tenn.
**INSTRUCTION MANUAL FOR ORNL TANDEM HIGH ABUNDANCE SENSITIVITY MASS SPECTROMETER**
David H. Smith, H. S. McKown, W. H. Chrisite, R. L. Walker, and J. A. Carter Jun. 1976 89 p refs
(Contract W-7405-eng-26)
(ORNL/TM-5485) Avail: NTIS HC A05/MF A01

The physical characteristics of the tandem mass spectrometer are described. Specific requirements include ability to run small samples, high abundance sensitivity, good precision and accuracy, and adequate sample throughput. Precision and accuracy are enhanced by a special sweep control circuit. Sample throughput is 6 to 12 samples per day. Operating instructions are also given. ERA

**N77-19405#** California Univ., Livermore. Lawrence Livermore Lab.
**FLASH RADIOGRAPHIC TECHNIQUE APPLIED TO FUEL INJECTOR SPRAYS**
Kerry Bahl, L. and Harry C. Vantine Jun. 1976 16 p refs

Presented at Am. Soc. for Nondestructive Testing Flash X-Ray Symp., Houston, Tex., 28 Sep. 1976
(Contract W-7405-eng-48)
(UCRL-78280; Conf-760914-4) Avail: NTIS HC A02/MF A01

A flash radiographic technique, using 50 ns exposure times, was used to study the pattern and density distribution of a fuel injector spray. The experimental apparatus and method are described. An 85 kVp flash X-ray generator was utilized. Radiographic images, recorded on standard X-ray films, were digitized and computer processed. ERA

**N77-19406#** New South Wales Univ., Kensington (Australia). School of Physics.
**CRYOGENIC INSTRUMENTATION NEEDS IN THE CONTROLLED THERMONUCLEAR RESEARCH PROGRAM**
P. L. Walstrom 10 Oct. 1976 11 p refs Presented at the ISA-76 Conf. and Exhibit, Houston, Tex., 10-14 Oct. 1976
(Contract W-7405-eng-26)
(CONF-761007-1) Avail: NTIS HC A02/MF A01

A survey of potentially applicable instrumentation is presented along with available information on operation in the test environment based on experimental data or on analysis of the physical characteristics of the device. Areas where further development work is needed are delineated. ERA

**N77-19407#** European Space Agency, Paris (France).
**THE FAINT OBJECT CAMERA (PHASE A). VOLUME 1: SUMMARY Final Report**
F. Macchetto, V. Manno, R. J. Laurance, R. F. Bonnefoy, C. H. Chapuis, A. P. Fournier-Sicre, J. A. F. Lizon-Tati, and H. H. Samuelsson Jul. 1976 107 p 4 Vol.
(Contract ESTEC-2552/75-PP(SC))
(ESA-CR(P)-857-Vol-1) Avail: NTIS HC A06/MF A01

Results are summarized of a study on the faint object camera, the ESA contribution to the NASA 2.4 m space telescope program. The camera is optimized for the imagery of faint objects and galaxies in the ultraviolet and visible regions of the spectrum. It will be able to detect objects of 28th visual magnitude in a ten-hour exposure and will have a spatial resolution of 0.1 arc second. The camera contains an optical relay to magnify the telescope focal plane, a set of filters, and an imaging detector system working in the photon counting mode. Four detector options were considered: I(4) system, electrostatic system C-I-EBS, I(2) system, and MCP system. Configuration and design aspects are surveyed. ESA

**N77-19408#** New Industrial Concepts Ltd., London (England).
**THE FAINT OBJECT CAMERA (PHASE A). VOLUME 2: DETECTOR DESIGN Final Report**
A. Boksenberg, P. J. Bowen, C. I. Coleman, R. Nettleship (Pye Telecommun. Ltd.), and D. Weighton (Pye Telecommun. Ltd.) 11 Jun. 1976 136 p refs 4 Vol.
(Contract ESTEC-2552/75-PP(SC))
(ESA-CR(P)-857-Vol-2) Avail: NTIS HC A07/MF A01

Detector options were considered for the faint object camera of the NASA 2.4 m space telescope. Performance figures were recalculated for the most promising systems identified during previous studies. The systems are the following: I4-P four-stage magnetic focus intensifier, lens coupled to PbO vidicon; I2-EBS two stage magnetic focus intensifier, lens coupled to 25 mm or (40 mm EBS tube; C-I-EBS (40) proximity-focused converter, 40/40 electrostatic intensifier, 40 mm EBS tube (fiber optic coupled); C-I-EBS (25) proximity-focused converter, 40/25 demagnifying electrostatic intensifier, 25 mm EBS tube (fiber optic coupled); and MCPw-P wafer MCP intensifier (curved channel MCP) lens coupled to PbO vidicon. The 12-EBS option was selected. The detector head unit is dealt with and the electronics is discussed. ESA

**N77-19409#** Dornier-System G.m.b.H., Friedrichshafen (West Germany).
**THE FAINT OBJECT CAMERA (PHASE A). VOLUME 4: MECHANICAL, THERMAL AND ELECTRICAL DESIGN Final Report**
L. Borucki, R. Katzenbeisser, A. Mauch, F. Pittermann, G. Polaczek, H. Raupp, H. Reffel, J. Schmidt, J. Schwarz, H. Schwille et al Jul. 1976 414 p refs 4 Vol.
(Contract ESTEC-2552/75-PP(SC))
(ESA-CR(P)-857-Vol-4) Avail: NTIS HC A18/MF A01

A study of the requirements on structural design, mechanisms, thermal control and electronics is presented. The major results are the mass budget, mass distribution, and overall power consumption; and they indicate that if the mechanical, thermal, and electronic requirements are satisfied, the camera can be built and operated in space for more than 2.5 years. Critical areas are surveyed, one of them being the optical bench. It is recommended that the bench be constructed in graphite/epoxy. ESA

**N77-19410#** Holosonics, Inc., Richland, Wash.
**DIVERSIFICATION OF ACOUSTICAL HOLOGRAPHY AS A NONDESTRUCT INSPECTION TECHNIQUE TO DETERMINE AGING DAMAGE IN SOLID ROCKET MOTORS Final Report**
H. Dale Collins Apr. 1976 117 p refs
(Contract F04611-75-C-0033; AF Proj. 3059)
(AD-A030319; AFRPL-TR-76-37) Avail: NTIS HC A06/MF A01 CSCL 14/2

The feasibility of using acoustical holography as a nondestructive technique for determining small innerbore cracks and debonds in larger solid rocket motors was demonstrated. Cracks as small as one inch long, one-half inch deep, and less than 0.002-in. thick located on the innerbore of simulated Minuteman first, second, and third stage motors (18-in. web-thickness) were readily identified. Unbonds of one square inch area between the case and propellant were imaged. Acoustic attenuation in TITAN III C type propellant was measured. Off axis scanning and concentric axial scanning were investigated. Author (GRA)

**N77-19411#** Naval Surface Weapons Center, Dahlgren, Va.
**CALIBRATION OF QUARTZ STRESS GAUGE CURRENT IN IMPACT EXPERIMENTS Final Report**
E. J. Shuler, W. Mock, Jr., and W. H. Holt Apr. 1976 18 p refs
(AD-A030095; NSWC/DL-TR-3490) Avail: NTIS HC A02/MF A01 CSCL 14/2

The calibration of quartz stress gauge output current for impact experiments is described. Details of the current calibration circuit and its operation are presented. The circuit features include external triggering, selectable pulse width, and selectable pulse repetition frequency. Precision amplitude current calibration signals are recorded along with the quartz gauge signal for accurate shock stress measurements. Author (GRA)

**N77-19412#** Naval Weapons Support Center, Crane, Ind.
**COMPUTERIZED RAPID-SCAN SPECTROSCOPY AT NAVWPNSUPPCEN CRANE Interim Report, 30 Jun. 1975 - 1 Jul. 1976**
Carl E. Dinerman 1 Jul. 1976 25 p refs
(AD-A030269; NWSC/CR/RDTR-35) Avail: NTIS HC A02/MF A01 CSCL 14/2

This report contains a description of a computerized spectroscopic data acquisition and analysis system used to analyze flare emission and smoke absorption. The system enables the computer generation of system corrected and signal averaged plots of spectral radiant intensity versus wavelength in the case of flare emissions, and the generation of plots of transmittance versus wavelength as a function of time in the case of smoke obscuration experiments. The system consists of several commercially available components. A dual channel scanning spectrometer, presently set up for the 1.7 to 4.7 micrometer region, enables spectra to be obtained repetitively with scan times of 1, 50, 100, or 500 msec, and with a resolution (at the slowest scan times) of 0.004 micrometers. Two channels of spectroscopic data, a number of channels of radiometric data, and various synchronization pulses are recorded on a 14-channel analog tape recorder. The spectroscopic and radiometric data are then digitized, using as many as 2,000 points per spectral scan per channel. System corrected, absolute intensity spectra are generated in the computer by calculations involving the flare spectral data, spectra of a Globlar source, and the radiometric data. The system is flexible in that a variety of gratings, filters, and detectors make it possible to use this system in the near ultraviolet, visible, near, and middle infrared. GRA

**N77-19413#** Ballistic Research Labs., Aberdeen Proving Ground, Md.
**DEVELOPMENT OF A COLOR IMAGE FORMATION SYSTEM Final Report**
William M. Frey and Lawrence J. VandeKieft Sep. 1976 21 p refs
(DA Proj. 1T1-61101-A-91A)
(AD-A030637; BRL-MR-2675) Avail: NTIS HC A02/MF A01 CSCL 14/5

A dual format color photograhic technique has been developed at the BRL in support of the DARCOM Target Signature Analysis Program, and is available for use with the BRL Hybrid Computer. One of the outputs of the Computer can be used to drive a Cathode Ray Tube display. The display is photographed with quickly interchangeable cameras to yield 35mm color slides and 3 1/4 in. by 4 1/4 in. Polaroid hard copy color prints. A full range of colors can be obtained by proper syncrhonization of CRT display and interchange of three additive filters. Color purity varies from 50 percent to 98 percent. Author (GRA)

**N77-19414#** Naval Surface Weapons Center, Dahlgren, Va.
**THE SPIKEDUCER: A TIME-OF ARRIVAL PIN CONFIGURATION FOR SHOCK WAVE EXPERIMENTS Final Report**
W. H. Holt, J. B. Bickley, and W. Mock, Jr. Jun. 1976 21 p
(AD-A030999; NSWC/DL-TR-3492) Avail: NTIS HC A02/MF A01 CSCL 14/2

An epoxy-encapsulated time-of-arrival pin and cable configuration (spikeducer) for use in shock wave experiments is described. The configuration provides a protective cover for a piezoelectric pin and facilitates accurate pin positioning in an experiment. A precision molding fixture has been designed for spikeducer fabrication. The details of fabrication and the application of spikeducers in a shock wave experiment are presented.
Author (GRA)

**N77-19415#** British Iron and Steel Research Association, London (England). Corporate Labs.
**ACTIVITY ENCODER AE-1. (ALSO KNOWN AS THE ACTIVITY CODE GENERATOR)**
H. Smialowski Aug. 1976 10 p
(PB-258931/5; BISRA-MC/TN/1/76) Avail: NTIS HC A02/MF A01 CSCL 14C

An instrument that monitors the tasks that a person performs while doing their job is described. Other possible applications of this device would be in the conduct of traffic surveys and related activities. The instrument comprises a key board of sixteen keys, a liquid crystal display, a timer start/stop switch. It is used with any four track tape recorder. There are two analog outputs, a digital output, and an on/off switch. The analog outputs each have four permissible levels and the digital output is in the form of a pulse. The timer start/stop switch is provided so that a timer can be controlled from the activity encoder. GRA

## 36 LASERS AND MASERS

Includes parametric amplifiers.

**N77-19416*** National Aeronautics and Space Administration. Pasadena Office, Calif.
**CONTINUOUS PLASMA LASER Patent**
Willard F. Libby (Calif. Univ., Los Angeles), Carl A. Jensen (Calif. Univ., Los Angeles), and Lowell L. Wood, inventors (to NASA) (Calif. Univ., Los Angeles) Issued 8 Feb. 1977 10 p Filed 10 Aug. 1971 Supersedes N72-21693 (10 - 12, p 1646) Division of US Patent Appl. SN-866442, filed 14 Oct. 1969, US Patent-3,617,804, which is a continuation-in-part of Abandoned US Patent Appl. SN-479357, filed 12 Aug. 1965 Sponsored by NASA
(NASA-Case-XNP-04167-3; US-Patent-4,007,430; US-Patent-Appl-SN-170544; US-Patent-Class-331-94.5D; US-Patent-Class-331-94.5G; US-Patent-Class-331-94.5PE; US-Patent-Appl-SN-479357) Avail: US Patent Office CSCL 20E

The apparatus includes a housing for confining a gas at subatmospheric pressure and including a set of reflectors defining an optical cavity. At least one anode and cathode are positioned within the gas. First control means control the voltage applied to the anode and second control means independently control the temperature of the cathode. The pressure of the gas is controlled by a third control means. An intense monochromatic output is achieved by confining the gas in the housing at a controlled pre-determined reduced pressure, independently controlling the temperature of the electron emitting cathode and applying predetermined controlled low voltage to the anode.
Official Gazette of the U.S. Patent Office

**N77-19417#** Lockheed Missiles and Space Co., Palo Alto, Calif.
**DESTRUCTION OF TRANSPARENT DIELECTRICS BY LASER RADIATION**
G. S. Khodakov and L. S. Tsesnek [1976] 26 p refs Transl. into ENGLISH from Opt.-Mekh. Prom. (USSR), v. 9, 1976 p 55-66
Avail: NTIS HC A03/MF A01; National Translation Center, John Crerar Library, Chicago, Illinois 60616

The optical strength of transparent dielectrics was investigated. The destruction of transparent dielectrics by high iptensity laser pulses occurs as the result of avalanche-like increasing absorption of light energy which can be caused by the formation of an electromagnetic pulse and by a grid of microdefects or cracks propagated at shock velocity. The mechanism is explained by heating of microscopic absorbing phase inclusions and/or increased electrical field intensity of the light wave in comparison to its electrical punch-through strength. I.M.

**N77-19418*#** National Aeronautics and Space Administration. Pasadena Office, Calif.
**CHARGE TRANSFER REACTION LASER WITH PREIONIZATION MEANS Patent Application**
James B. Laudenslager (JPL) and Thomas J. Pacala, inventors (to NASA) (JPL) Filed 12 Jul. 1976 24 p
(Contract NAS7-100)
(NASA-Case-NPO-13945-1; US-Patent-Appl-SN-704180) Avail: NTIS HC A02/MF A01 CSCL 20E

A helium-nitrogen laser is described in which energy in the visible range is emitted as a result of charge transfer reaction between helium ions and nitrogen molecules. The helium and nitrogen are present in a gas mixture at several atmospheres pressure, with a nitrogen partial pressure on the order of less than one percent. Prior to applying a discharge pulse to the gas mixture at the high pressure by means of a pair of main discharge electrodes, the gas mixture is preionized to prevent arcing when the discharge pulse is applied. NASA

**N77-19419#** Sandia Labs., Albuquerque, N.Mex.
**HIGH POWER ELECTRON BEAM ACCELERATORS FOR GAS LASER EXCITATION**
J. G. Kelly, T. H. Martin, and J. A. Halbleib Jun. 1976 37 p refs
(Contract AT(29-1)-789)
(SAND-75-5682) Avail: NTIS HC A03/MF A01

A preliminary parameter investigation was used to determine a possible design of a high-power, relativistic electron beam, transversely excited laser. Based on considerations of present and developing pulsed power technology, broad area diode physics and projected laser requirements, an exciter is proposed consisting of a Marx generator, pulse shaping transmission lines, radially converging ring diodes and a laser chamber. The accelerator should be able to deliver approximately 20 kJ of electron energy at 1 MeV to the 10000/sqcm cylindrical surface of a laser chamber 1 m long and 0.3 m in diameter in 24 ns with very small azimuthal asymmetry and uniform radial deposition. ERA

**N77-19420#** Sandia Labs., Albuquerque, N.Mex.
**LASER DRIVEN SUBNANOSECOND BLAST SHUTTER**
M. A. Duguay, M. A. Palmer, and R. E. Palmer 1976 15 p Presented at 20th. Ann. SPIE Tech. Symp., San Diego, Calif., 23 Aug. 1976
(Contract AT(29-1)-789)
(SAND-76-5362; Conf-760832-7) Avail: NTIS HC A02/MF A01

The opening time of the so-called blast shutter, presently used as an isolator in high-power laser systems, was measured. The shutter consists of a 275 A thick aluminum film deposited on a transparent plastic film. The aluminum film is suddenly

removed by exposing it to high-power pulses from a Nd:glass laser. Pulses 50 ps in duration were used that delivered between 0.5 and 3 J/sq cm of energy onto the aluminum film. The absorbed energy superheats the film and turns it into a rapidly expanding cloud of aluminum vapor. A blue laser beam from a CW argon laser passes through the shutter and is detected by an ultrafast streak camera, set for 50 ps resolution. With this arrangement, 10 to 90 percent shutter opening times varying from 0.8 to .4 ns have been measured, the former occurring at laser pulse energy densities of approximately 2 J/sq cm. ERA

**N77-19421#** Hughes Aircraft Co., Culver City, Calif. Laser Div.

**SHORT WAVELENGTH CHEMISTRY LASER STUDY Final Report**

J. H. S. Wang May 1976 47 p refs Sponsored by ERDA Prepared in cooperation with Calif. Univ., Livermore, Lawrence Livermore Lab.

(UCRL-13686) Avail: NTIS HC A03/MF A01

An attempt to measure the lifetime of CS(a(3)pi) state and its related quenching rates was performed using the flashlamp excitation technique. No emission in addition to the background signal was detected. A detailed calibration of the experimental apparatus indicates that the radiative lifetime of the CS(a(3)pi) state is most likely longer than 1,000 microsec. This long lifetime is beyond the range of interest for the possible development in the short wavelength chemical laser. ERA

**N77-19422#** California Univ., Livermore. Lawrence Livermore Lab.

**CONCENTRIC HEAT PIPE CAVITY FOR E-BEAM EXCITED LASERS**

F. B. Haller (NBS, Boulder, Colo.), M. M. Hessel (NBS, Boulder, Colo.), W. Neef, W. Lai, and H. Lohr 1976 7 p refs Presented at the 6th IEEE Symp. on Engineering Problems of Fusion Research, San Diego, Calif., 18-21 Nov. 1975

(Contract W-7405-eng-48)

(UCRL-77246; Conf-751125-144) Avail: NTIS HC A02/MF A01

A concentric heat pipe oven for metal vapor noble gas mixtures was designed and constructed as a high power laser cavity for laser fusion applications. A 1-MeV 100 KA 50 ns e-beam was injected into the oven through a 5 mil stainless steel foil window. Details of the construction and design consideration of the heat pipe oven, foil window and safety features are given. ERA

**N77-19423#** Mound Lab., Miamisburg, Ohio.

**PULSED LASER STEREO PHOTOGRAPHY OF MINIATURE EXPLODING FOILS**

Dennis L. Paisley 1976 5 p refs Presented at the 12th Intern. Congr. on High Speed Photography, Toronto, 1 Aug. 1976

(Contract E(33-1)-GEN-53)

(MLM-2341(OP); Conf-760828-2) Avail: NTIS HC A02/MF A01

A pulsed-laser stereophotography system is used to evaluate the physical changes taking place in close proximity to the actinic plasma of miniature exploding foils. The system records stereopairs of photographs at 3 ns exposure time and 20X magnification. The purpose of the laser is to supply a short (3 ns) pulse of monochromatic light. The metal foils provide satisfactory reflection, and the plasma acts as an optical absorber and provides for the necessary contrast. The camera includes 1.0-nm narrow-band-pass filters to prevent recording the exploding foil self-light. The stereopairs are read on a stereo-comparagraph normally used for aerial photographs that has been calibrated for reading these stereophotographs. Since these exploding foils have typical function times of 500 ns, the stereophotographs are synchronized in time with the event under test. Stereophotographs can be recorded at any preselected time to within plus minus 20 ns. This technique provides a means to evaluate closely events near optically intense plasma. ERA

**N77-19424#** Sandia Labs., Albuquerque, N.Mex.

**NEUTRONICS ANALYSIS FOR A SUBCRITICAL NUCLEAR LASER DRIVER EXCITED BY A FAST PULSE REACTOR**

Theodore R. Schmidt and David A. McArthur Apr. 1976 30 p refs

(Contract AT(29-1)-789)

(SAND-76-0139) Avail: NTIS HC A03/MF A01

Recent measurements at Sandia Laboratories demonstrated that a laser gas excited solely by fission products can be made to laser. The concept is explored of a subcritical nuclear driven laser (NDL) system excited by a fast pulse reactor of the Godiva type. A neutronics analysis, presented for a NDL system used with the SPR II/SPR III pulse reactors, indicates that megajoules of energy can be deposited in the laser gas in a time interval on the order of 150 to 200 microseconds. The data included would also be useful in the design of NDL experiments using the SPR reactors or serve as a parametric study for reactor excited NDL's. ERA

**N77-19425#** Sandia Labs., Albuquerque, N.Mex.

**SOFT X-RAY LASERS**

Michel A. Duguay 1976 23 p refs Presented at Summer Workshop on Synchrotron Radiation Facilities, Quebec, 14 Jun. 1976 Sponsored by ERDA

(SAND-76-5542; Conf-760650-1) Avail: NTIS HC A02/MF A01

Some of the work done to achieve X-ray laser action at wavelengths below 1000 A is reviewed. Four major approaches to X-ray lasers where experimental work was done are discussed. ERA

**N77-19426#** Sandia Labs., Albuquerque, N.Mex.

**VELOCITY MEASUREMENTS USING LASER INTERFEROMETRY WITH AUTOMATIC SIGNAL PROCESSING**

Robert A. Lederer 1976 18 p refs Presented at ELECTRO-76, Boston, 11 May 1976

(Contract AT(29-1)-789)

(SAND-76-5170; Conf-760502-2) Avail: NTIS HC A02/MF A01

Velocity interferometry is the technique of determining the velocity history of a specimen by illuminating it with a monochromatic light and optically detecting the small changes in frequency of the incident light caused by the specimen motion and carried in the reflected light. Velocity Interferometry System for Any Reflector (VISAR) was developed to measure the velocity of specimens with diffusely reflecting surfaces. The need for improvement led to the concept of a dual VISAR with an automatic data handling capability. The development of such a system is described here. The VISAR measures the velocity by collecting the data through an optical link and transfers representative electrical signals to the data handling system, where they are interpreted and displayed for analysis. ERA

**N77-19427#** Bendix Corp., Kansas City, Mo.

**INTEGRATING SPHERE PHOTODETECTOR FOR MEASUREMENT OF CONTINUOUS-WAVE AND PEAK LASER POWER**

L. D. Wonnell Aug. 1976 24 p refs

(Contract E(29-1)-613)

(BDX-613-1419) Avail: NTIS HC A02/MF A01

An integrating sphere photodetector utilizing an integrating sphere and a silicon photodiode sensor was developed for measuring both continuous wave and peak laser power over a spectral wavelength range from 514 to 1,064 nm with an estimated average power range from 100 micron W to 50 W and peak power greater than 1 kW. This universal detector simplifies optical coupling, improves the peak measurement accuracy of pulses having rise times greater than 10 ns, and increases the accuracy and repeatability of some continuous wave measurements applications. Its wide acceptance angle of approximately 30 deg provides a means of collecting all of the output from such widely diverging sources as laser diodes. ERA

**N77-19428#** Sandia Labs., Albuquerque, N.Mex.

**LASER BANDWIDTH REQUIREMENTS FOR DISTORTIONLESS AMPLIFICATION**

E. D. Jones Jun. 1976 14 p refs

(Contract AT(29-1)-789)

(SAND-76-0233) Avail: NTIS HC A02/MF A01

A set of universal curves for aiding in the design of a laser amplifier system with the requirement of minimum pulsewidth distortion is presented. ERA

**N77-19429#** California Univ., Livermore. Lawrence Livermore Lab.
**PROSPECTS FOR TRIVALENT RARE EARTH MOLECULAR VAPOR LASERS FOR FUSION**
William F. Krupke 12 Apr. 1976 11 p refs Presented at 12th Rare Earth Res. Conf., Vail, Colo., 18 Jul. 1976
(Contract W-7405-eng-48)
(UCRL-78058; Conf-760706-2) Avail: NTIS HC A02/MF A01

The dynamical properties of three types of RE(3+) molecular vapors were considered: (1) rare earth trihalogens, (2) rare earth trihalogens complexed with transition metal trihalogens, and (3) rare earth chelates. Radiative and nonradiative (unimolecular and bimolecular) transition probabilities were calculated using phenomenological models predicted on the unique electronic structure of the triply ionized RE ion. Although all the lanthanide ions were treated in some detail, specific results are presented for the Nd(3+) and Tb(3+) ions to illustrate the systematics of these vapors as a class of new laser media. Once verified, these phenomenological models provide a powerful tool for the directed experimental exploration of these systems. ERA

**N77-19430#** Sandia Labs., Albuquerque, N.Mex.
**HIGH ENERGY FLOWING NUCLEAR LASER**
P. B. Tollefsrud Apr. 1976 48 p refs Presented at Workshop on Nuclear Pumped Laser, Monterey, Calif., 6 Apr. 1976
(SAND-76-5341; Conf-760438-3) Avail: NTIS HC A03/MF A01

The nuclear pumped gasdynamic laser offers an alternative technology to comparable electrically driven systems with approximately the same weight and volume requirements. The largest advantage may be the ability to operate indefinitely in a steady-state mode at power levels in excess of 100 MW. The system is scalable to any energy. ERA

**N77-19431#** Sandia Labs., Albuquerque, N.Mex.
**DEVELOPMENT OF A HIGHER POWER FISSION-FRAGMENT-EXCITED CO LASER**
D. A. McArthur 1976 8 p refs Presented at Symp. on Uranium Plasmas, Princeton, N. J., 10 Jun. 1976 Sponsored by ERDA
(SAND-76-5440; Conf-760646-3) Avail: NTIS HC A02/MF A01

Since initial observation of lasing at lambda approximately 5 micron in cooled, reactor-excited CO, development of this laser was continued in a small experimental program. The early gain measurements and laser feasibility experiments did not use parameters typical of efficient electrical CO lasers, but did show that CO laser is promising as a potentially efficient reactor-excited laser. In recent experiments, it was observed that moderate dilution of the CO with Ar lowers the reactor excitation threshold for lasing. Very smooth and rugged fission coatings were developed on ceramic substrates, to minimize fouling of laser mirrors. Finally, a new laser apparatus was constructed which more closely resembles large electrically-excited CO lasers. In initial experiments this new laser has produced a laser energy approximately 15 mJ (or approximately 100 W peak power), which represents a factor of 50 increase in laser energy and a moderate increase in efficiency. ERA

**N77-19432#** California Univ., Livermore. Lawrence Livermore Lab.
**ANALYSIS OF THE FUSION-EFFECTIVENESS OF ACTIVE AND PASSIVE PULSE-STACKERS**
R. C. Harney and J. F. Schipper 2 Aug. 1976 16 p refs Presented at Conf. on Laser and Electrooptic Systems, San Diego, Calif., 25-27 May 1976
(Contract W-7405-eng-48)
(UCRL-77734; Conf-760513-10) Avail: NTIS HC A02/MF A01

Factors considered include efficiency, achievable rise-times, variety in output pulse shapes, simplicity of construction and operation, and compatibility with existing and proposed fusion laser systems. During the research phase of laser-fusion development a particular class of active pulse-stackers is superior, although a passive system, such as the KMSF pulse-stacker, is superior for use in a fusion reactor system. ERA

**N77-19433#** Technische Univ., Berlin (West Germany). Inst. fuer Luft- und Raumfahrt.
**LASER EQUIPMENT AND OPTOELECTRONIC SYSTEMS IN FLIGHT GUIDANCE AND SATELLITE TECHNOLOGY [LASERGERAETE UND OPTOELEKTRONISCHE SYSTEME IN DER FLUGFUEHRUNG UND SATELLITENTECHNIK]**
Wolfgang Holzapfel 1976 350 p refs In GERMAN; ENGLISH summary
(ILR-12; ISBN-3-7983-0561-7) Avail: NTIS HC A15/MF A01

A survey is presented of laser and optoelectronic applications for guidance and navigation of air and spacecraft; relevant trends of these new technologies and systems are pointed out. The applications are dominant in the field of communication and measuring techniques. The following subjects are included: Airborne and ground based laser communication, lidar for measuring range, position and velocity of air and spacecrafts, optical remote sensing and clear air turbulence detection, visual range measurement by laser, laser gyroscope and accelerometer, altitude and airspeed measuring laser techniques. Author (ESA)

**N77-19434#** TRW Systems, Redondo Beach, Calif.
**ADVANCED LASER CONCEPTS Final Report**
J. A. Betts and J. F. Friichtenicht Jul. 1976 190 p refs
(Contract F29601-73-A-0036; AF Proj. 1256)
(AD-A031010; AFWL-TR-75-289) Avail: NTIS HC A09/MF A01 CSCL 20/5

The major goal of the Advanced Laser Concepts contract is directed towards the understanding and development of chemically pumped electronic transition lasers. The program is divided into two separate tasks which use two approaches towards achieving the common goal. The first task is entitled Chemistry of Excited States. The approach used for this task is the investigation of the possibility of producing a chemically pumped visible or ultraviolet laser by means of chemically producing a metastable excited species which subsequently transfers its energy to a lasing species. The second task is entitled Molecular Beam Studies. The approach used in this task is to explore and screen a number of species as potential candidates for chemically pumped electronic transition lasers. The central experimental tool is a pulsed, high flux molecular beam apparatus. GRA

**N77-19435#** Frankford Arsenal, Philadelphia, Pa.
**ION BEAM SUPERPOLISHING OF METAL MIRRORS FOR HIGH ENERGY LASERS Final Engineering Report**
J. D. Lester, H. Gelles, and R. T. Cook Dec. 1975 25 p refs
(AD-A031106; FA-TR-75090) Avail: NTIS HC A02/MF A01 CSCL 20/5

A new process has been developed which employs a low energy ion beam to superpolish metal surfaces. The process is applicable in principle to all metals. This technique overcomes the tendency of metal surfaces to develop etch patterns and other surface irregularities during ion beam bombardment. The process produces superpolished optical surfaces significantly superior to those formed by conventional optical polishing or metallurgical techniques. Because ions of inert gases are employed for the superpolishing process the resultant surface is uncontaminated in contrast to conventional optical, chemical or metallurgical methods which result in diffusion of abrasion contamination or bronzed surfaces. In addition, this process may be employed for final figuring of optical surfaces. Author (GRA)

**N77-19436#** Army Missile Research, Development and Engineering Lab., Redstone Arsenal, Ala. Physical Sciences Directorate.
**LOW LOSS MODULATORS FOR INFRARED LASER**
G. A. Tanton and H. C. Meyer 25 May 1976 20 p refs
(DA Proj. 1W1-61102-AH-49)
(AD-A031170; RR-76-1) Avail: NTIS HC A02/MF A01 CSCL 20/5

This report shows how magneto-optical properties of bound state transitions may be used to design components significantly more efficient than conventional designs for infrared and submillimeter wavelengths. It is shown that magneto-optical spectroscopy can also provide information about basic parameters of a system not easily obtainable by other means. Author (GRA)

**N77-19437#** Lockheed Missiles and Space Co., Palo Alto, Calif. Research Lab.
**CORKSCREW EFFECT STUDY Final Report**
M. W. Munn and R. S. Benson Aug. 1976 63 p refs
(Contract F44620-75-C-0062; AF Proj. 9767)
(AD-A030931; LMSC-D508187; AFOSR-76-1100TR) Avail: NTIS HC A04/MF A01 CSCL 20/5

Linearized hydrodynamic equations are solved for the time-dependent density perturbation caused by propagation of a high energy laser beam. The transverse flow of air through the beam (due to any combination of wind, laser platform motion and slew angular velocity) can have any desired time dependence, both in magnitude and direction. At any distance z along the beam the solution gives the variation in refractive index (proportional to the density variation) as a function of position in a plane perpendicular to the optical axis. Wave optics calculations are made for the propagation of a beam subject to wind plus non-coplanar slew (for the steady-state situation). A scaling law is found for predicting the focal-plane peak irradiance from suitable coplanar calculations. Author (GRA)

**N77-19438#** Informatics, Inc., Rockville, Md.
**EFFECTS OF HIGH POWER LASERS, NO. 7 Interim Report, Nov. 1975 - Jun. 1976**
Stuart G. Hibben, J. Kourilo, M. Ness, and B. Shresta 27 Sep. 1976 134 p refs
(Contract MDA903-76-C-0099; DARPA Order 3097)
(AD-A030901) Avail: NTIS HC A07/MF A01 CSCL 20/5

This is the seventh compilation of abstracts of Soviet studies on high power laser technology, covering material published from November 1975 through June 1976. Articles are grouped by laser interaction with metals, dielectrics, semiconductors, miscellaneous targets, and laser-plasma interaction. A first-author index and an index of source abbreviations are appended. Author (GRA)

**N77-19439#** Army Electronics Command, Fort Monmouth, N.J.
**MEASUREMENTS AND ANALYSIS OF CARBON DIOXIDE BORON NITRIDE CHANNEL LASER Final Technical Report**
A. Papayoanou Sep. 1976 20 p refs
(DA Proj. 1S7-62703-DH-93)
(AD-A030927; ECOM-4430) Avail: NTIS HC A02/MF A01 CSCL 20/5

Carbon dioxide channel waveguide lasers have been constructed using hot pressed Boron Nitride. This smooth, easily machinable ceramic has high thermal conductivity and extremely low thermal expansion. These properties make it highly suitable for constructing compact, efficient, amplitude stable, tunable low power lasers. Results of measurements made are presented and analyzed. Author (GRA)

**N77-19440#** Aerospace Corp., El Segundo, Calif.
**THE USE OF HOLOGRAPHIC INTERFEROMETRY FOR NONDESTRUCTIVE TESTING OF LASER WINDOWS**
Lester Goldstein and Robert Cannada Sep. 1976 13 p refs
(Contract F04701-75-C-0076)
(AD-A031176; TR-0076(6516-03)-1; SAMSO-TR-76-213)
Avail: NTIS HC A02/MF A01 CSCL 20/5

The application of real time and double exposure holographic interferometry for the testing of induced strains, and internal flaws in laser windows has been explored. Techniques for employing these procedures are discussed, and holographic interferograms of several simulated stressed states of laser windows are included. The results indicate that these methods can be valuable nondestructive tools for the examination of nonuniform stresses induced by mounting hardware, and in addition, may provide for early detection of internal flaws within the window material. Author (GRA)

**N77-19441#** Harry Diamond Labs., Adelphi, Md.
**RARE-EARTH ION-HOST LATTICE INTERACTIONS. 10: LANTHANIDES IN Y2SiBe2O7**
Clyde A. Morrison, Nick Karayianis, and Donald E. Wortman Aug. 1976 71 p refs
(DA Proj. 1T1-61102-AH-44; HDL Proj. A44632)
(AD-A030849; HDL-TR-1766) Avail: NTIS HC A04/MF A01 CSCL 20/5

Theoretical crystal field parameters, Stark split energy levels, and squared matrix elements of the electric dipole operator between these Stark split energy states for the triply ionized lanthanide ions in diyttrium silicon beryllate are calculated. Lattice sums were performed to obtain crystal field components for the Y(3+) site by using reported X-ray data. GRA

**N77-19442#** Informatics, Inc., Rockville, Md.
**BIBLIOGRAPHY OF SOVIET LASER DEVELOPMENTS, NO. 23, JANUARY - MARCH 1976 Interim Report**
Stuart G. Hibben and Carl Minkus 15 Sep. 1976 154 p refs
(Contract MDA903-76-C-0254; DARPA Order 3097)
(AD-A030819) Avail: NTIS HC A08/MF A01 CSCL 20/5

This is the Soviet Laser Bibliography for the first quarter of 1976 and is No. 23 in the series on Soviet laser developments. The coverage includes basic research on solid state, liquid, gas, and chemical lasers; components; nonlinear optics; spectroscopy of laser materials; ultrashort pulse generation; crystal growing; theoretical aspects of advanced lasers; and general laser theory. Laser applications are listed under biological effects; communications; computer technology; holography; laser-induced chemical reactions; instrumentation and measurements; beam-target interaction; and plasma generation and diagnostics.
Author (GRA)

**N77-19443#** Air Force Weapons Lab., Kirtland AFB, N.Mex.
**A 15 KILOWATT CW CO2 COAXIAL ELECTRIC DISCHARGE LASER Final Report**
Randolph L. Carlson Aug. 1976 57 p refs
(AF Proj. 317J)
(AD-A030724; AFWL-317J) Avail: NTIS HC A04/MF A01 CSCL 20/5

The optimization of an Electric Discharge Coaxial Laser (EDCL) System is described. This CW carbon dioxide laser extracts power in excess of 15 kilowatts routinely at an electrical efficiency of 25 percent and a mass flow efficiency in excess of 100 kw/1b sub m/sec. With the appropriate resonator optics, the output intensity distribution is circular, uniform, temporarily stable, and repeatable within 5 percent. This EDCL is a high power output device offering simplicity of construction, low cost, high reliability, and ease of operation as compared to alternative transverse gas flow laser systems. Author (GRA)

**N77-19444#** Air Force Weapons Lab., Kirtland AFB, N.Mex.
**A FEASIBILITY EXPERIMENT FOR A SOFT X-RAY LASER Final Report**
G. R. Doughty, R. A. Wallner, and A. H. Guenther Sep. 1976 41 p refs
(AF Proj. 8809)
(AD-A030725; AFWL-TR-76-107) Avail: NTIS HC A03/MF A01 CSCL 20/5

X-ray lasing in the region of 44 to 117 A is possible using a mode-locked, picosecond Nd: glass laser as a pump. This report discusses the necessary conditions along with expected gain and loss mechanisms. Also detailed is a history of Air Force Weapons Laboratory involvement in this effort.
Author (GRA)

**N77-19445#** Maryland Univ., College Park. Dept. of Physics and Astronomy.
**DETECTION OF LASER LIGHT SCATTERED BY MATERIALS NEAR A PHASE TRANSITION Final Report, 1 Aug. 1970 - 31 Jul. 1976**
J. V. Sengers, C. O. Alley, R. F. Chang, H. B. Burstyn, and A. J. Ray Oct. 1976 25 p refs
(Contract N00014-67-A-0239-0014; N00014-76-C-0304)
(AD-A031029) Avail: NTIS HC A02/MF A01 CSCL 07/4

A summary is presented of a study of critical fluctuations using laser light scattering techniques. Highlights of the accomplishments are experimental verification of exponential decay of critical fluctuations and of the hypothesis of dynamical scaling, experimental observation of an effect of a viscosity anomaly on the decay rate of the fluctuations and experimental evidence for the principle of universality of the critical correlation function. It was decided to measure the critical fluctuations in the binary liquid 3-methylpentane-nitroethane. GRA

**N77-19446#** Aerospace Corp., El Segundo, Calif. Aerophysics Lab.
**TEMPORAL STABILITY OF UNSTABLE RESONATOR WITH CROSSFLOW Interim Report**
Harold Mirels 27 Aug. 1976 11 p refs
(Contract F04701-75-C-0076)
(AD-A030353; TR-0076(6725)-2; SAMSO-TR-76-201) Avail: NTIS HC A02/MF A01 CSCL 20/5

The temporal stability of the output from a CW laser that contains an unstable resonator with crossflow is investigated for cases where the population inversion is partially due to a pumping mechanism within the resonator. GRA

**N77-19447#** Aerospace Corp., El Segundo, Calif. Aerophysics Lab.
**FLOW-TUBE STUDIES OF VIBRATIONAL ENERGY TRANSFER IN DF(v) + HF,DF(v) + HF, AND DF(v) + D2 SYSTEMS**
Munson A. Kwok and Roger L. Wilkins 23 Aug. 1976 46 p refs
(Contract F04701-75-C-0076)
(AD-A029981; TR-0076(6603)-7; SAMSO-TR-76-195) Avail: NTIS HC A03/MF A01 CSCL 20/5

A medium-pressure (1 - Torr), large-diameter (10-cm) flow tube was used to measure rate coefficients at 298 K for (1) total relaxation (sum of vibrational-vibrational and vibrational-rotational, translational processes) of HF(v = 1, 2, 3, 4, and 5) by HF, (2) relaxation of DF(1, 2, 3, and 4) by HF, and (3) overall relaxation of DF(v = 1, 2, 3, and 4) by D2. The chemically produced vibrationally excited HF or DF species were studied by monitoring their vibrational-rotational emission in a fast-flow system. The rate coefficients for the vibrational-rotational, translational de-excitation from the upper vibrational levels of DF(v) by HF had a nonlinear vibrational dependence. GRA

**N77-19448#** Army Environmental Hygiene Agency, Aberdeen Proving Ground, Md.
**NONIONIZING RADIATION PROTECTION SPECIAL STUDY: EXEMPTION FROM NEW FEDERAL LASER PERFORMANCE STANDARDS FOR TACTICAL ARMY LASER SYSTEMS AND FIELD TRAINING LASERS**
David H. Sliney Jul. 1976 22 p refs
(AD-A029453; USAEHA-42-303-76) Avail: NTIS HC A02/MF A01 CSCL 20/5

A special study dealing with the requirements of an exemption from the new Federal laser performance standards on tactical Army laser systems was conducted by this Agency. It was determined that the exemption will have an immediate impact upon tactical lasers now in production. It was also evident that a military standard or specification would greatly aid in the implementation of the intent of the exemption to assure system safety features in tactical lasers. GRA

**N77-19449#** Naval Postgraduate School, Monterey, Calif.
**APERTURE AVERAGING EFFECTS ON SCINTILLATION AND THE TEMPORAL-FREQUENCY POWER SPECTRUM M.S. Thesis**
Howard Robert Hall Jun. 1976 135 p refs
(AD-A030084) Avail: NTIS HC A07/MF A01 CSCL 20/5

Aperture averaging effects on the measurement of scintillation and on the temporal-frequency power spectrum have been examined in the marine boundary surface layer using a He-Ne (6328 A) laser beam propagating over various path lengths and under varying turbulence conditions. Two significant results have been obtained: (1) For scintillation measurements, a vanishingly small receiver can best be approximated by using an aperture of diameter Dmin = (Z/k) sup (1/2). (2) The aperture averaging correction factor for an aperture diameter D = Dmin decreases as the level of turbulence increases. Data have also been obtained supporting the theoretical prediction that an increase in aperture diameter reduces the high frequency power content of the temporal-frequency power spectrum. GRA

**N77-19450#** Naval Postgraduate School, Monterey, Calif.
**DESIGN AND CONSTRUCTION OF AN IODINE LASER OSCILLATOR M.S. Thesis**
Frederick Charles Marcell, Jr. Jun. 1976 83 p refs
(AD-A030032) Avail: NTIS HC A05/MF A01 CSCL 20/5

A small photochemical dissociation gas laser oscillator has been constructed for use in the study of laser characteristics, energy extraction techniques, and plasma production. It operates with a mixture of perfluorinated-propyliodide and argon as an active medium. The laser is pumped by ultraviolet light in a 500 A wide band centered around 2,680 A. GRA

**N77-19451#** Naval Research Lab., Washington, D.C.
**LASER-FUSION STUDIES AT NRL. A REPORT TO ERDA FOR THE PERIOD JULY 1974 - JUNE 1975**
S. E. Bodner Aug. 1976 184 p refs
(NRL Proj. H02-29A)
(AD-A029408; NRL-MR-3315) Avail: NTIS HC A09/MF A01 CSCL 20/5

This report summarizes work done at NRL on laser fusion related to problems during FY 1975. Included are sections related to laser development and to experimental studies of laser plasma interaction. Author (GRA)

**N77-19452#** Naval Research Lab., Washington, D.C.
**DARPA-NRL LASER PROGRAM. REPORT TO DEFENSE ADVANCED RESEARCH PROJECTS AGENCY Semiannual Technical Report, 1 Jul. - 31 Dec. 1975**
J. R. Airey, R. Burnham, L. Champagne, N. Dejeu, and J. Eversole Aug. 1976 173 p refs
(DARPA Order 2062; NRL Proj. N01-48; NRL Proj. K03-53)
(AD-A029359; NRL-MR-3341) Avail: NTIS HC A08/MF A01 CSCL 20/5

The DARPA-NRL Laser Program is concerned with the development of laser technology in three project areas: chemical infrared lasers, electrical infrared lasers and electronic-state lasers. The chemical infrared laser program includes studies of pulsed HCl laser systems and molecular energy transfer processes. Data have been collected which suggests that intramolecular energy transfer occurs in SF6 at a rate 1,000 times the gas kinetic collision rate. The electrical infrared program emphasizes electric-discharge gasdynamic lasers and electron-beam pumping of potential laser systems in the mid-infrared. Several new energy transfer lasers have been discovered and a detailed discussion of the study of direct excitation HCl lasers is given. A number of excitation approaches are being evaluated for application to electronic state gas lasers. A most important step in the development of rare-gas halide lasers is the reporting here of the operation of XeF and KrF lasers in self-sustained discharges. Chemical pumping of atomic states is shown to lead to sufficient population for lasing and related quenching studies are described. Transverse discharge excitation of metal vapor lasers has been reduced to practice and coherent anti-Stokes Raman spectroscopy is being developed for probing the number density and vibrational temperature of gaseous species in a lasing medium. Author (GRA)

**N77-19453#** TRW Defense and Space Systems Group, Redondo Beach, Calif.
**JAN PROPAGATION PROGRAM. PROPAGATION ANALYSIS REPORT Final Report, Feb. 1975 - Jul. 1976**
J. D. OKeefe, P. J. Lynch, R. Margulies, A. Murthy, and D. Bullock Jul. 1976 77 p refs
(Contract N00014-75-C-0484)
(AD-A029750; TRW-27677-6005-RU-00) Avail: NTIS HC A05/MF A01 CSCL 20/5

The objectives of this program were to measure the performance of the BDL resonator and optical train during Series A and the Atmospheric propagation during Series B. In addition, an objective was to determine the degree of correlation between the present state knowledge of resonator, optical train and atmospheric propagation theory and experiment. All of the above objectives were met. The performance of the resonator and optical train was measured to the degree necessary to understand the device propagation characteristics. The above measurements were compared with resonator code predictions of the outcoupled fields and spectrum, and calculations of the propagation of the fields through a model of the optical train. The atmospheric propagation measurements were compared with multispectral blooming code calculation of the propagation of the resonator code predictions. The propagation calculations agreed on the average to within 20% with the measured values. The BDL (Baseline Demonstration Laser) is a large CW,

combustion-driven DF chemical laser capable of an output in excess of 65 KW. The optical train utilized in these experiments utilized a beam expansion/projector telescope with an aperture of 72 cm. During the course of the measurements the laser output beam was propagated over ranges of 0.5 and 1.5 KM.
Author (GRA)

**N77-19454#** University of Southern Calif., Los Angeles. Center for Laser Studies.
**EVALUATION OF Nd:YVO4 AND Ho:Er:Tm:YVO4 AS PULSE PUMPED Q-SWITCHED LASERS Final Report, 1 Jan. 1974 - 1 Apr. 1975**
Michael Bass, Larry G. DeShazer, and Perry P. Yaney Jan. 1976 126 p refs
(Contract DAAB07-74-C-0104; DA Proj. 1S7-62703-A-186) (AD-A029916; ECOM-74-0104-F) Avail: NTIS HC A07/MF A01 CSCL 20/5

This program was designed to develop and exploit rare-earth doped yttrium orthovanadate (YVO4) as a high efficiency laser material. The effort included crystal growth, spectroscopy and laser performance testing. Though emphasis was placed on the spectroscopic and laser properties of Nd(3+) ions, the spectroscopy of Ho(3+) ions with Er(3+) and Tm(3+) co-dopants was also studied. GRA

**N77-19455#** Washington Univ., Seattle.
**NEW INFRARED LASER CONCEPTS Semiannual Technical Report, 1 Dec. 1975 - 31 May 1976**
Walter H. Christiansen 15 Sep. 1976 12 p refs
(Contract N00014-75-C-0316; ARPA Order 2840)
(AD-A030077) Avail: NTIS HC A02/MF A01 CSCL 20/5

A study of the possibilites of tunable high power gas lasers is being carried out at the University of Washington. These lasers are also characterized by high energy storage density and are suitable for efficient short pulse operation. This class of lasers is based on the use of homonuclear molecules which normally do not have an infrared radiation spectrum, except under special conditions when collisionally induced dipoles introduce both absorption and emission spectra. These lasers exhibit exceptionally broad band characteristics, low gain and high saturation power. As part of this interest, the possibilites of lasing homonuclear moleculear molecules such as H2 or N2 directly without the use of permanent dipole additives is being studied. Basically the idea is to produce an inversion in a gas by a high-pressure e-beam-stabilized electric discharge and then induce radiative transitions via collision partners or electric discharge and then induce radiative transitions via collision partners or electric fields. Of the many molecular possibilities, H2 has been chosen as a likely candidate for such a laser because of its relatively short wavelength transitions (2.8 micrometers) and easily achieved population inversion. The induced dipole laser (collisional or external electric field induced) represented by this study will be a unique laser. The physics of this laser are different in many ways to more conventional lasers and the laser system would show these differences. For example, the extremely wide bandwidth is a consequence of collisional phenomena at high pressures and not apparent in conventional lasers. GRA

**N77-19456#** General Electric Co., Philadelphia, Pa. Space Sciences Lab.
**DISCHARGE HEATED METAL VAPOR LASER STUDIES: IMPROVED PERFORMANCE OF COPPER AND LEAD LASERS**
B. G. Bricks, R. S. Anderson, and T. W. Karras 3 Feb. 1977 24 p refs
(Contracts F33615-76-C-1137; N00014-76-C-0975)
(Doc-77SDS013) Avail: GE Space and RESD Libraries, P.O. Box 8555, Philadelphia, Pa. 19010l; HC $10.00/MF $10.00

A program to improve the operating characteristics of a discharge-heated copper vapor laser is described (copper DHVL). Output power and efficiency were increased by volume scaling, and operating lifetime was extended by new copper loading techniques. Beam divergence was controlled by using an unstable resonator. The copper laser output was also frequency doubled and used as a pulsed dye laser pump source. Finally, a lead DHVL was optimized for performance at 7229 A. Author

**N77-19102*#** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**LOW-NOISE RECEIVERS: MICROWAVE MASER DEVELOPMENT**
R. Quinn and E. Wiebe *In its* The Deep Space Network 15 Feb. 1977 p 78-82 refs (For primary document see N77-19091 10-12)
Avail: NTIS HC A13/MF A01 CSCL 20E

# 37 MECHANICAL ENGINEERING

Includes auxiliary systems (non-power); machine elements and processes; and mechanical equipment.

**N77-19457*** National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
**GUIDE FOR A TYPEWRITER Patent**
Robert D. Dubois (Boeing Co., Huntsville, Ala.) and George T. Pinson, inventors (to NASA) (Boeing Co., Huntsville, Ala.) Issued 2 Nov. 1976 4 p Filed 9 Aug. 1973 Supersedes N73-31438 (11 - 22, p 2676) Sponsored by NASA
(NASA-Case-MFS-15218-1; US-Patent-3,989,136; US-Patent-Appl-SN-387094; US-Patent-Class-197-188; US-Patent-Class-197-190) Avail: US Patent Office CSCL 13I

The invention relates to accessories for typewriters, and more particularly to an improved guide for use in aligning a sheet of paper preparatory to an application of typed indicia to selected spaces. The device includes an aligning plate pivotally mounted on a line guide having formed therein a plurality of aligned apertures. The plate is so positioned that an aperture is positioned immediately above a target area for a type slug so that a slug will imprint a character in selected spaces.
Official Gazette of the U.S. Patent Office

**N77-19458*** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**CYCLICAL BI-DIRECTIONAL ROTARY ACTUATOR Patent**
William C. Stange, inventor (to NASA) Issued 1 Mar. 1977 12 p Filed 17 Jul. 1975 Supersedes N75-29430 (13-20, p 2526)
(NASA-Case-GSC-11883-1; NASA-Case-GSC-11974-1; NASA-Case-GSC-11975-1; US-Patent-4,010,455; US-Patent-Appl-SN-596787; US-Patent-Class-340-224; US-Patent-Class-310-4A; US-Patent-Class-60-527; US-Patent-Class-75-170; US-Patent-Class-337-334; US-Patent-Class-75-122.7) Avail: US Patent Office CSCL 13I

A thermally powered rotary actuator is disclosed which is used for positioning a shaft in first and second positions which are disposed 180 deg apart. A pair of heat extensible springs are attached to the shaft and to the frame of the rotary actuator for selectively rotating the shaft from one of its two positions to the other position upon the application of heat to one of the heat extensible springs. The heat extensible springs are preferably constructed from the alloy 55-Nitinol. In the preferred embodiment, a detent mechanism is provided for locking the rotatable shaft in its two rotary positions.
Official Gazette of the U.S. Patent Office

**N77-19459*#** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
**SEQUENCING DEVICE UTILIZING PLANETARY GEAR SET Patent Application**
Walter T. Appleberry, inventor (to NASA) (Rockwell Intern. Corp., Downey, Calif.) Filed 25 Feb. 1977 12 p
(Contract NAS9-1400)
(NASA-Case-MSC-19514-1; US-Patent-Appl-SN-772168) Avail: NTIS HC A02/MF A01 CSCL 13I

A planetary (epicyclic) gear set is provided with a continuously rotating input and individual outputs actuated, respectively, by the ring gear and planet gear carrier. Latch means is positioned to selectively stop one of the ring gear and carrier members while starting the other to provide the desired sequential output operation. NASA

**N77-19460#** Los Alamos Scientific Lab., N.Mex.
**EXPLOSION METAL WELDING**

Alexis A. Popoff 1976 13 p Presented at the Interagency Mechanical Operations Group Meeting, Golden, Colo., 2-3 Mar. 1976
(Contract W-7405-eng-36)
(LA-UR-76-1457; Conf-760352-2) Avail: NTIS HC A02/MF A01

Process parameters pertaining to welding similar and dissimilar metals using explosives are reviewed. The interrelationship of physical parameters which play a part in achieving desirable metallurgical results are discussed. Present activities in explosion metal welding at LASL are presented and how they are related to the interests of the ERDA community is shown. ERA

**N77-19461#** Oak Ridge Y-12 Plant, Tenn. Dept. of Metallurgical Development.
**ELECTRON BEAM, MULTIPASS, WIRE-FED WELDING OF TYPE 5083 ALUMINUM**
J. L. Murphy Jul. 1976 18 p refs
(Contract W-7405-eng-26)
(Y-2050) Avail: NTIS HC A02/MF A01

The versatility and advantages of electron-beam, multipass, wire-fed welding were demonstrated on 5.33 and 1.52 mm thick type 5083 aluminum cylinders by making full penetration welds that had controlled inner distortion and minimum porosity. A comparison was made between the mechanical properties of gas tungsten-arc welds; electron-beam, wire-fed welds compared favorably with the yield strength of the arc welds and autogenous, electron-beam welds. The tensile strength of the electron-beam, wire-fed welds is reduced, because of the depletion of some magnesium from the weld, resulting in a weld-joint efficiency of approximately 74 percent. ERA

**N77-19462#** Oak Ridge Y-12 Plant, Tenn. Dept. of Fabrication Services.
**MACHINE TOOL EVALUATION**
B. E. Lunsford 16 Apr. 1976 14 p ref Presented at a Region 5 Seminar on Practical Applications in Manufacturing, Gatlinburg, Tenn., 23 Apr. 1976
(Contract W-7405-eng-26)
(Y/NA-361; Conf-760468-5) Avail: NTIS HC A02/MF A01

The use of a laser interferometer to determine tool-path capabilities is described. ERA

**N77-19463#** Paducah Gaseous Diffusion Plant, Ky.
**POWER SHAFTING: KEYS AND KEYWAYS**
William C. Orthwein 1976 48 p refs Presented at Am. Soc. of Mech. Engr. Design Technol. Transfer Conf., Montreal, Canada, 3 Oct. 1976
(Contract W-7405-eng-26)
(KY-G-311; Conf-761009-1) Avail: NTIS HC A03/MF A01

A review of the history of the analysis of torsionally induced shaft stresses due to the inclusion of an empty keyway, or keyseat, is given with emphasis placed upon experimentally measured values. More realistic stresses recently found by photoelastic analysis of a shaft in which the keyways were not empty are then presented. A new, patented (U.S. Patent 3,920,343, Nov. 18, 1975 assigned to the U.S.), and operating key and keyway design which resulted from these tests, wherein the twisting forces were actually applied through the keys, is described. ERA

**N77-19464#** Mound Lab., Miamisburg, Ohio.
**SPIN CRIMPING CONCEPT AND PROCESS EQUIPMENT FOR ASSEMBLING COMPONENTS**
4 Jun. 1976 16 p refs
(Contract E(33-1)-GEN-53)
(MLM-2279) Avail: NTIS HC A02/MF A01

A force-controlled spin crimping system was designed and fabricated to mechanically attach a thin walled aluminum cup over the stepped outer diameter of a circular DAP (diallyl phthalate) plastic head. This system is a bench-type unit and meets the requirements for use in a Class II, Group G explosive environment. A process development study was conducted to determine a reliable spin crimping method, and process and prototype testing was performed to verify the proposed design criteria. The crimping system featured another process control whereby the part prepared for assembling was not crimped if the clamping force did not meet preset minimum-maximum force range limits. Another fail-safe device included an overdrive shutdown control to prevent part or system damage due to a force limit malfunction. ERA

**N77-19465#** Sandia Labs., Albuquerque, N.Mex.
**NOVEL ZrO2-PT SEAL FOR O2 SENSORS**
Gary S. Snow and Paul D. Wilcox Jul. 1976 27 p refs Presented at 1975 Joint Fall Meeting of the Basic Sci. and Electron. Div. of the Am. Ceram. Soc., Indianapolis, 22-24 Sep. 1975
(Contract AT(29-1)-789)
(SAND-76-0329; Conf-7509140-1) Avail: NTIS HC A02/MF A01

A novel method for sealing Pt to ZrO2 was developed. The sealing technique, which involves deformation of a platinum seal ring against the ZrO2 parts, is simple and reliable and offers distinct advantages over prior technology for sealing ZrO2 probes for remote oxygen sensing. Seal strength was determined as a function of sealing temperature and load. The sealing method and its application to oxygen sensors are described.
Author (ERA)

**N77-19466#** Mound Lab., Miamisburg, Ohio.
**STREAK CAMERA TECHNIQUE TO MEASURE PLASTIC PLATE VELOCITIES AS A CONTINUUM**
Dennis L. Paisley 1976 4 p Presented at the 12th Intern. Congr. on High Speed Photography, Toronto, 1 Aug. 1976
(Contract E(33-1)-GEN-53)
(MLM-2342(OP); Conf-760828-5) Avail: NTIS HC A02/MF A01

A technique was developed to measure velocities of thin plastic plates as a continuum with a streak camera at 20 mm/microsecond and 8.4X magnification. The plastic plates are bonded to an exploding foil with a transparent cylindrical barrel located over the exploding foil/plastic laminate on the side of the plastic plate. When the foil is exploded, a plastic plate is torn from the laminate and accelerated through the barrel. The velocity, acceleration, and displacement of 76 micron thick plastic plates moving through a 1 mm diameter barrel 1.5 mm long is recorded on the streak camera. Velocities to 4 mm/microsecond have been recorded. The actual streak record of the flying plates is recorded when the slit of the streak camera is parallel to the axis of the barrel cylinder. The barrel is backlighted with an exploding wire synchronized to function with the event under test. This method provides a shadowgraph record of the flying plate. ERA

**N77-19467#** California Univ., Livermore. Lawrence Livermore Lab.
**VARIABLE ORIFICE FOR DIFFERENTIAL PUMPING IN A VACUUM SYSTEM**
R. Beeman and S. Brajkovich 11 Jun. 1976 4 p
(Contract W-7405-eng-48)
(UCID-17155) Avail: NTIS HC A02/MF A01

In differential pumping, the pumping speed has been controlled by the size of the orifice between the vacuum chamber and the diffusion pump. To change the speed, the valve must be removed and another valve with an orifice of a different size must be inserted. A simple shutter that controls pumping speed without requiring any change in components was developed. The shutter consists of 20 leaves arranged as an iris that opens to a 6-in.-dia orifice or closes to 0.25 in. The shutter consists of a mounting ring, the leaves, a drive ring, and a drive gear. Each leaf is stainless steel with a pivot pin at one end and an offset pin at the other. The leaves are placed in the mounting ring and the drive ring and the drive gear are attached. Rotating the drive gear moves the leaves and changes the orifice size. One of the shutters was used successfully with a 4-in. diffusion pump system. In this system the pressure is 100 microns in the vacuum chamber and 0.0001 microns at the diffusion pump. The shutter was placed above the cold trap so it could be used for both diffusion pumping and roughing. ERA

**N77-19468#** Westinghouse Electric Corp., Madison, Pa. Advanced Reactors Div.
**ESTIMATES OF THE BURST RELIABILITY OF THIN-WALLED CYLINDERS DESIGNED TO MEET THE ASME CODE ALLOWABLES**
P. A. Stancampiano (Swanson Engineering Associates Corp.) and

P. P. Zemanick 1976 32 p refs Presented at Intern. Joint Pressure Vessels and Piping and Petrol. Mech. Eng. Conf., Mexico City, 19 Sep. 1976
(Contract AT(11-1)-2395)
(CONF-760905-11) Avail: NTIS HC A03/MF A01

Pressure containment components in nuclear power plants are designed by the conventional deterministic safety factor approach. The bursting probability that the operating pressure is greater than the burst strength of the cylinders is calculated using stress-strength interference theory by direct Monte Carlo simulation on a high speed digital computer. A sensitivity study is employed to identify those design parameters which have the greatest effect on the reliability. The effects of preservice quality assurance defect inspections on the reliability are also evaluated parametrically. ERA

**N77-19469#** California Univ., Livermore. Lawrence Livermore Lab.
**METHANOL ENGINE: A TRANSPORTATION STRATEGY FOR THE POST-PETROLEUM ERA**
H. C. Vantine, J. Chang, L. G. OConnell, B. Rubin, and C. Westbrook 25 Mar. 1976 34 p refs
(Contract W-7405-eng-48)
(UCRL-52041) Avail: NTIS HC A03/MF A01

Several types of heat engines are considered as candidates for a methanol engine. A stratified charge engine optimized for methanol fuel is projected to result in an energy economy advantage of 44 to 71 percent in comparison to an Otto engine operating on gasoline. This advantage arises from (1) the high octane rating of the fuel, which allows a high compression ratio to be used; (2) methanol's fuel-lean combustion characteristics, which allow efficient lean operation; and (3) the low flame temperature, which allows effective control of nitrogen oxide emissions. The design and optimization of a methanol engine are examined in terms of an experimental and calculational program. The socioeconomic impact of methanol fueled transportation is discussed. ERA

**N77-19470#** Ford Motor Co., Dearborn, Mich.
**AUTOMOTIVE GAS TURBINE CERAMIC REGENERATOR DESIGN AND RELIABILITY PROGRAM Progress Report, 1 Apr. - 30 Jun. 1976**
J. A. Cook, C. A. Fucinari, J. N. Lingscheit, and C. J. Rahnke Jul. 1976 125 p refs
(Contract E(11-1)-2630)
(COO-2630-15) Avail: NTIS HC A06/MF A01

The ERDA/Ford Ceramic Regenerator Design and Reliability Program developed ceramic regenerator cores that can be used in passenger car gas turbine engines, Stirling engines, and industrial/truck gas turbine engines. Improved materials and design concepts aimed at reducing or eliminating chemical attack were placed on durability test in Ford 707 industrial gas turbine engines late in 1974. There were 2,700 hours of turbine engine durability testing accumulated during the second quarter of 1976. Two materials, aluminum silicate and magnesium aluminum silicate continue to show promise toward achieving the durability objectives of this program. Regenerator cores made from aluminum silicate show no evidence of chemical attack damage after 5,000 hours of engine test. ERA

**N77-19471#** Compliance Testing, Inc., Ravenna, Ohio.
**TEST PROGRAMS TO DETERMINE PERFORMANCE CAPABILITY OF WHEEL/RIM ASSEMBLIES Final Report, May 1972 - Oct. 1975**
James E. Shearer Sep. 1976 49 p ref
(Contract DOT-HS-026-2-430)
(PB-259009/9; DOT-HS-802-032) Avail: NTIS HC A03/MF A01 CSCL 13F

Three test methods were used: (1) dynamic fatigue test, (2) dynamic cornering fatigue 90 degrees; and (3) dynamic cornering fatigue 40 degrees. Further testing was suggested to establish definite limits of dish and impressed load in the case of radial fatigue. GRA

**N77-19472#** Bendix Corp., South Bend, Ind. Energy Controls Div.
**FLUIDIC COMPRESSOR BLEED VALVE Final Technical Report, Jun. 1974 - Jun. 1976**
James M. Eastman 3 Jun. 1976 105 p refs
(Contract F33615-74-C-2068; AF Proj. 3066)
(AD-A030049; ECD-862-18998-R; AFAPL-TR-76-50) Avail: NTIS HC A06/MF A01 CSCL 21/5

Changing compression ratio with compressor corrected speed change, causes changes in relative air densities and flow velocities in the stages. At less than design speed, the increased relative flow velocities needed in the later stages causes them to act as a throttle on the early stages, tending to drive them into compressor stall. Bleeding air from the front stages averts this. The required bleeding is most precisely determined by the relation of the compression ratio of the final stages to the over-all compression ratio. Fluidic technology readily provides this - using flowing air computation circuits and an amplifier to position a diaphragm operated poppet type bleed valve. The computer modeling, design, and successful bench substantiation tests of the Mode AV-N2 fluidic compressor bleed valve for the Teledyne CAE Model 472-11D engine, are described. Planned engine testing was cancelled when engine development was stopped. An application survey was made, with requirements for six other small engines being studied. The survey indicated (1) the fluidic approach could meet the requirements for all the engines, and (2) its superior accuracy potential could benefit by either reducing excessive parasitic air bleeding or allowing design trade-offs for size, weight, response, etc. Author (GRA)

**N77-19473#** General Electric Co., Cincinnati, Ohio.
**FAIL-FIXED SERVOVALVE Final Technical Report, Feb. 1974 - Feb. 1976**
Howard Kast Wright-Patterson AFB, Ohio AFAPL Feb. 1976 198 p
(Contract F33615-74-C-2007; AF Proj. 3066)
(AD-A030151; R-76-AEG-265; AFAPL-TR-76-24) Avail: NTIS HC A09/MF A01 CSCL 13/11

This report describes the design and development of an electrohydraulic servovalve that fails the output actuator of a servo system 'in position' upon the loss of electrical input signal or a hard-over electrical signal in either direction. GRA

**N77-19474#** Office of Naval Research, London (England).
**AN INDUSTRIAL TECHNOLOGY CALLED TRIBOLOGY: THE UK EXPERIENCE AND ITS IMPLICATIONS**
Robert H. Nunn and Herbert Herman 27 Aug. 1976 40 p refs
(AD-A030898; ONRL-R-7-76) Avail: NTIS HC A03/MF A01 CSCL 20/11

Tribology, defined as the science and technology of interacting surfaces in relative motion and of related subjects and practices, is the result of a series of UK activities, begun in 1966, to provide remedies to certain industrial ills. This report, intended for the general reader, is an overview of the birth, growth, and present state of tribology in the UK. The actions of the Committee on Tribology are discussed, as well as those of the Tribology Centres and other UK organizations concerned with lubrication and wear. Relevant but broader issues are also discussed. These include the interdisciplinary approach, effective communication between academia and industry, and the concept of industrial technologies. Comments are offered concerning the lessons to be learned from the UK experience. Appendices provide brief descriptions of the proposed educational module in tribology, the symposium titled 'Tribology 1976,' and the practice of lubrication analysis including ferrography. Author (GRA)

**N77-19475#** Army Mobility Equipment Research and Development Center, Fort Belvoir, Va.
**HYPERVELOCITY-IMPACT SHOCK-INDUCED DAMAGE TO STEEL ARMOR**
John W. Bond, Jr. Apr. 1976 32 p refs
(AD-A029425; USAMERDC-2174) Avail: NTIS HC A03/MF A01 CSCL 19/4

The object of this research was to develop the physics of hypervelocity-impact induced spallation to the extent that small 1-g projectiles can be designed to optimize backface spall in steel armor. Over 100 successful impact experiments and their metallurgical analysis were completed. Some preliminary heuristic spallation theory was developed. The importance of the 130-kbar phase change and adiabatic shear in martensitic steel is discussed. A preliminary conclusion is that such projectiles

can be designed; however, more research is needed for optimization. Author (GRA)

**N77-19476#** Naval Weapons Center, China Lake, Calif.
**DYNAMICS OF THE OBLIQUE IMPACT AND RICOCHET OF NONDEFORMING SPHERES AGAINST THIN PLATES Final Report**
Marvin E. Backman and Stephen A. Finnegan Sep. 1976 73 p refs
(WF32353501)
(AD-A030268; NWC-TP-5844) Avail: NTIS HC A04/MF A01 CSCL 19/4

The dynamics of the impact of hard spheres against mild steel and aluminum alloy plates has been investigated by using an analytical model of impact dynamics to interpret experimental data. The analytical model assumes rigid body response of the sphere to forces on the sphere expressed as a quadratic function of the speed of impact and a factor equal to the presented area of contact between the sphere and plate. The dependence of the force on speed is determined by an empirical correlation of the constants in the quadratic function experimental measurements of the residual speed for impacts at normal incidence. The failure of the plates is modeled by the removal of resisting force over predetermined areas once critical depths of penetration have been exceeded. GRA

# 38 QUALITY ASSURANCE AND RELIABILITY

Includes product sampling procedures and techniques; and quality control.

**N77-19477*#** Westinghouse Electric Corp., Pittsburgh, Pa.
**RADIOGRAPHIC AMPLIFIER SCREENS: FABRICATION PROCESS AND CHARACTERISTICS Final Report**
Zoltan Szepesi Mar. 1977 27 p refs
(Contract NAS3-19902)
(NASA-CR-2822; Rept-76-9G9-RASPA-R1) Avail: NTIS HC A02/MF A01 CSCL 14D

The fabrication process and transfer characteristics for solid state radiographic image transducers (radiographic amplifier screens) is described. These screens were developed for use in real time nondestructive evaluation procedures that require large format radiographic images with contrast and resolution capabilities unavailable with conventional fluoroscopic screens. This work was directed toward screens usable for inmotion, on-line radiographic inspection by means of closed circuit television. Author

**N77-19478#** Sandia Labs., Livermore, Calif.
**APPLICATION OF HOLOGRAPHIC INTERFEROMETRY TO THE INSPECTION OF HERF STAINLESS STEEL PRESSURE VESSELS**
D. A. Tichenor, K. W. Henry, and R. W. Gorman Jun. 1976 17 p refs Presented at Am. Soc. for Nondestructive Testing Flash X-Ray Symp., Houston, 27 Sep. 1976
(Contract AT(29-1)-789)
(SAND-76-8656; Conf-760914-6) Avail: NTIS HC A02/MF A01

Holographic interferometry is demonstrated as a useful technique for inspecting small stainless steel pressure vessels machined from High Energy Rate Forged (HERF) material. This multistep forging process alters the mechanical properties of the material as the part is formed. Errors in the forging process can result in local or uniform reductions in tensile strength. Flaws of this type increase the amount of residual deformation which occurs as a result of pressure testing. Holographic interferometry is well suited to the measurement of the residual deformation because: (1) the deformations of interest are very small, and (2) the entire surface of the vessel must be inspected. Holographic interferograms of good-quality and poor-quality forgings are presented together with a set of accept-reject criteria to be used in a routine testing environment. ERA

**N77-19479#** Sandia Labs., Livermore, Calif.
**PERFORMANCE AND INSPECTION OF FLAWED PRESSURE VESSELS**
L. W. Dahlke, W. E. Jorgenson, H. J. Saxton, and A. R. Willis Jun. 1976 42 p refs Presented at Am. Soc. for Nondestructive Testing Flash X-Ray Symp., Houston, 27 Sep. 1976
(Contract AT(29-1)-789)
(SAND-76-8654; Conf-760914-5) Avail: NTIS HC A03/MF A01

The effects of flaws on pressure vessel performance and the ability of NDT techniques to detect and actively monitor these flaws prior to and during burst testing were studied. Twenty flawed and unflawed spherical pressure vessels fabricated from several stainless steels and a titanium alloy were evaluated. The flaws ranged from circumferential machined slots on the inner surface to weld voids and lack of penetration. This interdisciplinary study employed (1) radiography to characterize the defects, (2) acoustic emission and holography during proof-testing to detect the flaws and unsatisfactory structural performance, (3) radiography and acoustic emission to monitor flaw and vessel growth during hydrostatic burst testing, and (4) extensive materials and structural evaluations. ERA

**N77-19480#** Mound Lab., Miamisburg, Ohio.
**SEMI-AUTOMATED X-RAY GUAGING SYSTEM WITH COMPUTERIZED DATA ACQUISITION AND DOCUMENTATION**
Charles F. Draut and D. A. Homan 1976 5 p refs Presented at Joint Automatic Control Conf., Lafayette, Ind., 27 Jul. 1976
(Contract E(33-1)-GEN-53)
(MLM-2343(OP); Conf-760726-1) Avail: NTIS HC A02/MF A01

An X-ray gauging method was developed and a production gauging system was subsequently fabricated to control the quality of precision manufactured components. The gauging system measures via X-ray absorption the density of pressed finely divided solids held in a dissimilar container. The two dissimilar materials condition necessitated a 'two scan' technique: first the X-ray attenuation (absorption) of the empty container prior to loading, and then, the attenuation of the loaded container are measured; that is, four variables. The system provided product control via timely data feedback and increased product quality assurance via 100 percent inspection of product. In addition, it reduced labor costs, product cost, and possibilities for human errors. ERA

**N77-19481#** Technische Univ., Berlin (West Germany). Inst. fuer Luft- und Raumfahrt.
**APPLICATION OF MONTE CARLO METHODS TO DETERMINATION OF RELIABILITY CHARACTERISTICS OF TECHNICAL SYSTEMS [ANWENDUNG VON MONTE-CARLO-VERFAHREN ZUR ERMITTLUNG VON ZUVERLAESSIGKEITSMERKMALEN TECHNISCHER SYSTEME]**
Leonidas Kamarinopoulos 1976 93 p refs In GERMAN
(Contract DFG-Pe-179/2)
(ILR-14; ISBN-3-7983-0563-3) Avail: NTIS HC A05/MF A01

Various simulation methods (Monte Carlo methods), as well as their applicability to determination of important reliability characteristics such as failure probability, availability, and mean time to failure of complex systems, were investigated. Three computer programs were developed from the theoretical models: LEMA 0, LEMA 1, and LEMA 2. The LEMA 0 program is a direct simulation program, whereas LEMA 1 and 2 are based on weighting. The latter programs obtain a variance reduction based on the weighting, and this means a reduction in computer time. ESA

**N77-19482#** California Univ., Berkeley. Operations Research Center.
**TECHNIQUES FOR ANALYZING MULTIVARIATE FAILURE DATA**
Richard E. Barlow and Frank Proschan (Fla. State Univ.) Apr. 1976 34 p refs
(Contract N00014-75-C-0781; AT(49-24)-0147; Grants NSF MPS-95-14194; AF-AFOSR-2581-74; NR Proj. 042-238)
(AD-A029721; ORC-76-11) Avail: NTIS HC A03/MF A01 CSCL 14/4

New multivariate techniques for analyzing multivariate life

test data are introduced. The hazard gradient is estimated using the multivariate piecewise exponential distribution model. An example based on caterpillar tractor data is analyzed. Isoprobability contours are used to analyze joint distribution structure. Author (GRA)

**N77-19483#** Army Scientific Advisory Panel, Washington, D.C.
**REVIEW OF DARCOM'S USE OF RELIABILITY GROWTH MANAGEMENT TECHNIQUES**
Gerhard Reethof 1 Aug. 1976 17 p
(AD-A031102) Avail: NTIS HC A02/MF A01 CSCL 14/4

A review of reliability growth management techniques attempts to answer the questions: Is the reliability growth effort, as currently applied, a worthwhile activity in terms of aiding the decision-making processes and affecting the course of development programs? Specifically, has the reliability growth methodology affected decisions at the technical and managerial level? How can the reliability growth concept application be strengthened and improved? Author (GRA)

# 39 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; and thermal stress.

For applications see *05 Aircraft Design, Testing and Performance* and *18 Spacecraft Design, Testing and Performance*.

**N77-19484#** Lockheed Missiles and Space Co., Palo Alto, Calif.
**ON APPLICATION OF THE MOIRE METHOD TO INVESTIGATE VISCOPLASTIC FLOW**
I. Naumann [1976] 9 p refs Transl. into ENGLISH from Vestn. Mos. Univ., Mat. Mekh. (USSR), v. 5, 1976 p 88-96
Avail: NTIS HC A02/MF A01; National Translation Center, John Crerar Library, Chicago, Illinois 60616

The Moire method was used to analyze processes of pressure treatment of metals. An experimental-theoretical method to study strain and stress fields for the viscoplastic flow of media without memory is proposed. Author

**N77-19485#** Lockheed Missiles and Space Co., Palo Alto, Calif.
**EXPERIMENTAL INVESTIGATION OF THE STABILITY OF COMPOSITE SHELLS**
A. P. Budnik, V. I. Vorotnikov, V. V. Ershov, V. V. Novikovich, and F. A. Shalitkin [1976] 5 p refs Transl. into ENGLISH from Prikl. Mekhan. (USSR), v. 12, no. 11, 1976 p 120-123
Avail: NTIS HC A02/MF A01; National Translation Center, John Crerar Library, Chicago, Illinois 60616

An experimental investigation of the stability of hinge supported cylindrical and composite shells subjected to uniform external pressure was performed. The shell thickness varies linearly along the meridian, diminishing from the middle towards the edges. Composite shells are formed by cylindrical and conical parts of identical length joined coaxially. Four series of shells, six pieces in each series, were tested. One series contains three shells of constant and three of linearly varying thickness. Author

**N77-19486*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**LOAD-DISPLACEMENT MEASUREMENT AND WORK DETERMINATION IN THREE-POINT BEND TESTS OF NOTCHED OR PRECRACKED SPECIMENS**
Robert J. Buzzard and Douglas M. Fisher 1977 16 p refs Presented at the Task Group E-24.01.09 of the Am. Soc. for Testing and Mater. Comm., Norfolk, Va., 22-25 Mar. 1977
(NASA-TM-X-73596; E-8378) Avail: NTIS HC A02/MF A01 CSCL 13M

Suggestions for testing of notched or cracked three-point bend specimens are presented which: (1) correct displacement measurement errors resulting from misalignment between the load applicator and specimen; (2) account for coincidental strains not associated with the work of crack extension; (3) simplify record analysis and processing; and (4) extend displacement gage range without sacrifice of sensitivity or accuracy. These testing details are particularly applicable to procedures in which the crack extension force is determined from the work done on the specimen. Author

**N77-19487*#** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
**STRUCTURAL STIFFNESS, STRENGTH AND DYNAMIC CHARACTERISTICS OF LARGE TETRAHEDRAL SPACE TRUSS STRUCTURES**
Martin M. Mikulas, Jr., Harold G. Bush, and Michael F. Card Mar. 1977 50 p refs
(NASA-TM-X-74001) Avail: NTIS HC A03/MF A01 CSCL 13M

Physical characteristics of large skeletal frameworks for space applications are investigated by analyzing one concept: the tetrahedral truss, which is idealized as a sandwich plate with isotropic faces. Appropriate analytical relations are presented in terms of the truss column element properties which for calculations were taken as slender graphite/epoxy tubes. Column loads, resulting from gravity gradient control and orbital transfer, are found to be small for the class structure investigated. Fundamental frequencies of large truss structures are shown to be an order of magnitude lower than large earth based structures. Permissible loads are shown to result in small lateral deflections of the truss due to low-strain at Euler buckling of the slender graphite/epoxy truss column elements. Lateral thermal deflections are found to be a fraction of the truss depth using graphite/epoxy columns. Author

**N77-19488*#** Bell Helicopter Co., Fort Worth, Tex.
**CORRELATION OF AH-1G AIRFRAME TEST DATA WITH A NASTRAN MATHEMATICAL MODEL**
James D. Cronkhite and Victor L. Berry Feb. 1976 160 p refs
(Contract NAS1-13801)
(NASA-CR-145119; Rept-699-099-016) Avail: NTIS HC A08/MF A01 CSCL 13M

Test data was provided for evaluating a mathematical vibration model of the Bell AH-1G helicopter airframe. The math model was developed and analyzed using the NASTRAN structural analysis computer program. Data from static and dynamic tests were used for comparison with the math model. Static tests of the fuselage and tailboom were conducted to verify the stiffness representation of the NASTRAN model. Dynamic test data were obtained from shake tests of the airframe and were used to evaluate the NASTRAN model for representing the low frequency (below 30 Hz) vibration response of the airframe. Author

**N77-19489*#** Stanford Univ., Calif.
**FINITE STATE MODELING OF AEROELASTIC SYSTEMS**
Ranjan Vepa Washington NASA Feb. 1977 189 p refs
(Grant NGL-05-020-243)
(NASA-CR-2779) Avail: NTIS HC A09/MF A01 CSCL 13M

A general theory of finite state modeling of aerodynamic loads on thin airfoils and lifting surfaces performing completely arbitrary, small, time-dependent motions in an airstream is developed and presented. The nature of the behavior of the unsteady airloads in the frequency domain is explained, using as raw materials any of the unsteady linearized theories that have been mechanized for simple harmonic oscillations. Each desired aerodynamic transfer function is approximated by means of an appropriate Pade approximant, that is, a rational function of finite degree polynomials in the Laplace transform variable. The modeling technique is applied to several two dimensional and three dimensional airfoils. Circular, elliptic, rectangular and tapered planforms are considered as examples. Identical functions are also obtained for control surfaces for two and three dimensional airfoils. Author

**N77-19490#** Cornell Univ., Ithaca, N.Y.
**MECHANICAL BEHAVIOR OF MATERIALS AND STRUCTURAL ELEMENTS AT ELEVATED TEMPERATURES**
**Progress Report, 1 Jun. 1975 - 31 May 1976**
R. H. Lance and S. Mukherjee May 1976 21 p refs
(Contract E(11-1)-2733)
(COO-2733-5) Avail: NTIS HC A02/MF A01

Research performed on the mechanical behavior of materials and structural elements at elevated temperatures is summarized. The analytical portion of the research performed includes solutions

of several boundary value problems for structural components subjected to steady loads with and without steady thermal gradients using Hart's constitutive relations for the material. Study of crack propagation in a ductile material was initiated. The experimental portion of the research, designed to perform creep experiments on structural components at room and elevated temperatures, was started. ERA

**N77-19491#** California Univ., Berkeley. Lawrence Berkeley Lab.

**MECHANISMS OF DUCTILE FRACTURE**

Mark Walter Perra Jan. 1976 150 p refs

(Contract W-7405-eng-48; Grant NSF ENG-74-24365)

(LBL-4901) Avail: NTIS HC A07/MF A01

Experiments were conducted which determined the growth of an isolated cylindrical void in plane strain. Graphite filaments, which served as nonadhering void nuclei, were embedded in copper plane-strain specimens in such a way that their cylindrical axes lay normal to the plane of deformation. Two filament configurations were studied: the filaments were either isolated or were arranged in a periodic array. Nucleation of voids at secondary sites in the matrix was suppressed by using high-purity copper. Two work-hardening rates were obtained by preparing specimens in both the annealed and highly cold-worked conditions. After the local work-hardening rate had fallen below a critical value in the necks of the unnotched plane-strain tensile specimens, slipping off occurred along planes of maximum shear stress. Quadrangular channels were observed in the necks of these specimens, indicating void growth by localized shear. ERA

**N77-19492#** Oak Ridge Y-12 Plant, Tenn. Dept. of Metallurgical Development.

**ROLE OF FERRITE AND PHOSPHORUS PLUS SULPHUR IN THE CRACK SENSITIVITY OF AUTOGENOUSLY WELDED TYPE 309 STAINLESS STEEL**

F. J. Lambert, Jr. Jul. 1976 19 p refs

(Contract W-7405-eng-26)

(Y-2049) Avail: NTIS HC A02/MF A01

Autogenous welding of thin stainless steel sheet was made after experiencing cracking difficulties on several commercial heats. A relationship exists between the sum of the phosphorus plus sulfur, the ferrite control of the weld metal, and the crack sensitivity of autogenously made welds. A new simple weld test for thin-gage sheet is utilized for studying the susceptibility to cracking. A chemistry modification is suggested to alleviate possible weld cracking when autogenously welding this grade. The principles of crack sensitivity prediction could apply to other austenitic stainless steel types where chemistry limits are such that ferrite is possible. ERA

**N77-19493#** Sandia Labs., Albuquerque, N.Mex.

**NUMERICAL INTEGRATION OF A SPALL DAMAGE VISCOPLASTIC CONSTITUTIVE MODEL IN A ONE-DIMENSIONAL WAVE PROPAGATION CODE**

M. E. Kipp and A. L. Stevens Jun. 1976 60 p refs

(Contract AT(29-1)-789)

(SAND-76-0061) Avail: NTIS HC A04/MF A01

A description is given of the incorporation of a model for spall damage in ductile metals into the one-dimensional Lagrangian wavecode. The constitutive equations modeling the thermomechanical behavior of the damaged viscoplastic material are given as a system of seven first order ordinary differential equations. In any zone-cycle, these equations are integrated by the variable order, variable step Adams-method code. Sample calculations for a plane impact case illustrate the interaction of the accumulating damage with the stress wave. Included are brief parameter studies which indicate the dependence of the damage on the viscoplastic model. Back surface velocity histories are compared with experimental records. ERA

**N77-19494#** Atomics International, Golden, Colo.

**INVESTIGATION OF FRACTURE IN PRESSURIZED GAS METAL ARC WELDED BERYLLIUM**

Clinton R. Heiple, R. J. Merlini, and R. O. Adams 20 May 1976 14 p refs

(Contract E(29-2)-3533)

(REP-2463) Avail: NTIS HC A02/MF A01

Premature failures during proof testing of pressurized-gas-metal-arc (PGMA) welded beryllium assemblies were investigated. The failures were almost entirely within the beryllium, close to and parallel to the weld interface. The aluminum-silicon weld filler metal deposit was not centered in the weld groove in the failed assemblies, and failure occurred on the side of the weld opposite the bias in the weld deposit. Tensile tests of welded samples demonstrated that the failures were unrelated to residual machining damage from cutting the weld groove, and indicated small lack-of-fusion areas near the weld start to be the most likely origin of the failures. Acoustic emission was monitored during tensile tests of the welds. The majority of acoustic emission was probably from crack propagation through the weld filler metal. ERA

**N77-19495#** Brown Univ., Providence, R. I. Div. of Engineering.

**FINITE DEFORMATION ANALYSIS OF CRACK TIP OPENING IN ELASTIC-PLASTIC MATERIALS AND IMPLICATIONS FOR FRACTURE INITIATION**

Robert M. McMeeking May 1976 70 p refs

(Contract E(11-1)-3084)

(COO-3084-44) Avail: NTIS HC A04/MF A01

Analyses of the stress and strain fields around smoothly blunting crack tips in both non-hardening and hardening elastic-plastic materials, under contained plane strain yielding and subject to mode I opening loads, were carried out by a finite element method suitably formulated to admit large geometry changes. The results include the crack tip shape and near-tip deformation field, and the crack tip opening displacement was related to a parameter of the applied load, the J-integral. The hydrostatic stresses near the crack tip are limited due to the lack of constraint on the blunted tip, limiting achievable stress levels except in a very small region around the crack tip in power law hardening materials. ERA

**N77-19496#** Brown Univ., Providence, R. I. Div. of Engineering.

**LOCALIZATION OF PLASTIC DEFORMATION**

James R. Rice Apr. 1976 16 p refs Presented at 14th Intern. Congress of Theoretical and Applied Mech., Delft, Neth., 30 Aug. 1976

(Contract E(11-1)-3084),

(COO-3084-43; Conf-760835-1) Avail: NTIS HC A02/MF A01

The localization of plastic deformation into a shear band is discussed as an instability of plastic flow and a precursor to rupture. Experimental observations are reviewed, a general theoretical framework is presented, and specific calculations of critical conditions are carried out for a variety of material models. The interplay between features of inelastic constitutive description, especially deviations from normality and vertex-like yielding, and the onset of localization is emphasized. ERA

**N77-19497#** Oak Ridge National Lab., Tenn.

**EXPERIMENTAL STRESS ANALYSES OF CYLINDER-TO-CYLINDER SHELL MODELS AND COMPARISONS WITH THEORETICAL PREDICTIONS**

R. C. Gwaltney, J. M. Corum, S. E. Bolt, and J. W. Bryson 1976 38 p refs Presented at Intern. Joint Pressure Vessels and Piping and Petroleum Mechanical Engr. Conf., Mexico City, 19 Sep. 1976

(Contract W-7405-eng-36)

(CONF-760905-5) Avail: NTIS HC A03/MF A01

The models were idealized structures consisting of two circular cylindrical shells intersecting at right angles. The first model tested had a nozzle-to-cylinder diameter ratio of 0.5 and a diameter-to-thickness of 100 for both nozzle and cylinder. The second model had a nozzle-to-cylinder diameter ratio of 1.0 with a diameter-to-thickness ratio of 100. The third and fourth models had a nozzle-to-cylinder ratio of 0.129. For these models the diameter-to-thickness ratio was 50 for the cylinders and 7.68 for the nozzle of model 3, while it was 20.2 for the nozzle of model 4. All models were strain gaged and subjected to 13 separate loading cases. Comparisons of measured and predicted stress distributions are presented for three of these loadings - internal pressure, and in-plane and out-of-plane moments applied to the nozzle. ERA

**N77-19498#** Combustion Engineering, Inc., Chattanooga, Tenn.
**EXPERIMENTAL STRESS ANALYSIS FOR FOUR 24-INCH ANSI STANDARD B16.9 TEES**
J. K. Hayes and S. E. Moore (ORNL) 1976 63 p refs Presented at Intern. Joint Pressure Vessels and Piping and Petrol. Mech. Eng. Conf., Mexico City, Mex., 19 Sep. 1976 Sponsored by ERDA
(CONF-760905-1) Avail: NTIS HC A04/MF A01

The experimental stress analysis and low cycle fatigue tests of four tees are described. These tests are part of the ORNL design criteria for piping and nozzles program which is being conducted for the development of design criteria for nuclear power plant service piping components. The test assemblies were fabricated from commercially obtained ANSI B16.9 tees and matching diameter steel pipes welded to the tees, with suitable closures and fixtures for applying the loads. ERA

**N77-19499#** Blume (John A.) and Associates Research Div., San Francisco, Calif.
**MEASUREMENTS AND EVALUATION OF BUILDING RESPONSE TO GROUND MOTION AT VARIOUS STAGES OF CONSTRUCTION**
Kenneth K. Honda 1976 16 p refs Presented at the Am. Soc. of Civil Engr. Conf., Madison, Wis., 23 Aug. 1976 Sponsored by ERDA
(Conf-760809-1) Avail: NTIS HC A02/MF A01

At low levels of motion where the partitions contribute lateral stiffness to the system, they carry a proportional amount of the total lateral load and add sizable energy-absorbing capacity to the system. However, when the partitions are removed, the load formerly carried by the partitions is again transferred to the structural system. Because of the different response mode shapes of the models, the interstory drift at the first floor for the same roof displacement can vary significantly among models. In the models studied, the building without partitions at the first floor had the largest interstory drift. ERA

**N77-19500#** California Univ., Livermore. Lawrence Livermore Lab.
**DYNAMIC FRACTURE ANALYSIS WITH A LAGRANGIAN FINITE DIFFERENCE METHOD**
Yung M. Chen and Mark L. Wilkins 10 Jun. 1976 28 p refs Presented at the Conf. on Dynamic Fracture Toughness, London, 5-7 Jul. 1976; sponsored by the Welding Inst. and the Am. Soc. for Metals
(Contract W-7405-eng-48)
(UCRL-77257-Rev-1; Conf-760705-2) Avail: NTIS HC A03/MF A01

Two and three-dimensional time-dependent explicit finite-difference methods are used to analyze the stress field around cracks subjected to dynamic tensile loads. Several different notch radii of a notched central crack in a rectangular bar with plane strain loading are studied. The case of a central crack in a thin rectangular plate (near plane stress geometry) is also studied. The stress field around a through-the-thickness crack in a section of a cylindrical pipe loaded by a sudden application of pressure is calculated. The plastic strain field around an edge crack in a bar is calculated in plane strain and plane stress geometry. Extrapolation methods are used to determine dynamic stress conditions at the tip of sharp cracks in elastic materials. For rounded cracks, or a crack blunted by plastic flow, the dynamic stress state at a crack tip can be calculated directly. ERA

**N77-19501#** Oak Ridge National Lab., Tenn.
**ANALYTICAL RELATIONS BETWEEN ELASTIC-PLASTIC FRACTURE CRITERIA**
J. G. Mrekle Jul. 1976 20 p refs
(Contract W-7405-eng-26)
(ORNL/NUREG/TM-27; NRC-5) Avail: NTIS HC A02/MF A01

The equation of the normalized COD design curve recently proposed in the U.K. as a basis for determining allowable crack sizes is derived from the equivalent energy approximation for the J integral. It is also shown that another approximation for the J integral recently proposed by Westinghouse is mathematically equivalent to the normalized COD approach. ERA

**N77-19502#** Energy Research and Development Administration, Oak Ridge, Tenn.
**FLEXA: A CONVENIENT FORTRAN PROGRAM FOR FLEXIBILITY AND STRESS ANALYSES OF PLAIN PIPING SYSTEMS**
H. Schnauder Jan. 1976 39 p refs Transl. into ENGLISH from German Report
(EURFNR-1333; KFK-2241) Avail: NTIS HC A03/MF A01

The program can be used in time sharing operation through TSO (time sharing option of OS/360) as well as in batch operation. Only few data are necessary for the input, e.g. only the length and inclination for a straight piping element and the radius of curvature and the two angles including the bend for a bent piping element. The temperature dependent material data for the types of steel are taken from a program internal library. Besides the usual list output, it is possible to plot the shape of the piping system in a simple true-to-scale drawing. In time sharing operation the representation is achieved via the display, in batch operation via the plotter. ERA

**N77-19503#** Sandia Labs., Albuquerque, N.Mex.
**INFINITE TENSILE CYLINDER WITH CIRCUMFERENTIAL EDGE CRACK**
L. M. Keer, J. M. Freedman, and H. A. Watts May 1976 25 p refs
(Contract AT(29-1)-789)
(SAND-76-0202) Avail: NTIS HC A02/MF A01

The problem of a tensile cylinder of infinite length with a circumferential edge crack is solved. Integral transform techniques are used to reduce the given problem to a singular integral equation, where the unknown function to be determined is a dislocation density. The singular integral equation is solved numerically, and values obtained for the stress intensity factor are compared. ERA

**N77-19504#** Argonne National Lab., Ill.
**UNIFIED AND MECHANISTIC APPROACH TO CREEP-FATIGUE DAMAGE**
S. Majumdar and P. S. Maiya Jan. 1976 32 p refs
(Contract W-31-109-eng-38)
(ANL-76-58) Avail: NTIS HC A03/MF A01

A creep fatigue damage rate equation is proposed that takes into account both plastic strain and strain rate. The coefficients and exponents in the damage rate equation are interpreted by means of the various damage mechanisms of the material. The damage rate equation was integrated to analyze various phenomena such as the effects of plastic strain rate on monotonic tensile or creep rupture time, rising mean strain on the low cycle fatigue behavior at elevated temperature, tensile and compressive hold times on the low-cycle fatigue life at elevated temperature, and cyclic creep. The proposed approach was successfully applied to elevated temperature data generated for type 304 austenitic stainless steel under various monotonic and cyclic-loading conditions. The approach does not separate the inelastic strain into plastic (time independent) and creep (time dependent) components. ERA

**N77-19505#** Cornell Univ., Ithaca, N.Y. Dept. of Materials Science and Engineering.
**ELASTIC AND PLASTIC DEFORMATION OF SOLIDS Final Report, 1 Feb. 1970 - 31 Jan. 1976**
Arthur L. Ruoff 15 Jul. 1976 9 p refs
(Contract E(11-1)-3153)
(COO-3153-141) Avail: NTIS HC A02/MF A01

The techniques used and the results obtained in the study creep at high pressure dependence of yield stress and elastic constants are summarized. Author (ERA)

**N77-19506#** Sandia Labs., Albuquerque, N.Mex.
**INELASTIC RESPONSE OF A NUCLEAR PIPE ELBOW SUBJECTED TO RUPTURE FORCES**
Johnny H. Biffle and M. H. Gubbels 1976 32 p refs Presented at the Intern. Joint Pressure Vessels and Piping and Petroleum Mechanical Engineering Conf., Mexico City, 19 Sep. 1976
(Contract AT(29-1)-789)
(SAND-75-5120; Conf-760905-9) Avail: NTIS HC A03/MF A01

The response of pipe elbow subjected to rupture forces is

calculated with a technique capable of describing the large-deformation inelastic dynamic response of a three-dimensional structure. The method is a mixed finite element technique. ERA

**N77-19507#** National Bureau of Standards, Washington, D.C.
**CONSIDERATION OF FRACTURE MECHANICS ANALYSIS AND DEFECT DIMENSION MEASUREMENT ASSESSMENT FOR THE TRANS-ALASKA OIL PIPELINE GIRTH WELDS, VOLUME 1 Final Report**
Harold Berger and John H. Smith 18 Oct. 1976 184 p refs
(Contract DOT-AS-70006)
(PB-260400/7; NBSIR-76-1154-Vol-1; DOT/MTB/OPSO-76/02) Avail: NTIS HC A09/MF A01 CSCL 13K

In anticipation of a request for waivers on defective girth welds in the Trans-Alaska oil pipeline, DOT requested assistance from the National Bureau of Standards (NBS) in evaluating the fracture mechanics analysis and the nondestructive evaluation (NDE) methods used to detect and determine dimensions of weld defects. NBS measured the required mechanical properties of the weld metal, developed and evaluated fracture mechanics methods to determine the allowable defect sizes, and evaluated various methods of measuring the size of defects present in the welds from existing field radiographs. Results of this investigation show that the fracture mechanics analysis can be used to determine the allowable defect sizes concerning the integrity of the pipeline, but that these analyses have not been experimentally verified at this time. Defect dimensions can be determined with sufficient accuracy to be useful in the fracture mechanics analyses if the radiographs are made under carefully controlled conditions. If the radiographs are not made with close control, the accuracy of the defect sizes may not be sufficient to permit their use in establishing allowable defect sizes. GRA

**N77-19508#** National Bureau of Standards, Washington, D.C.
**CONSIDERATION OF FRACTURE MECHANICS ANALYSIS AND DEFECTS DIMENSION MEASUREMENT ASSESSMENT FOR THE TRANS-ALASKA OIL PIPELINE GIRTH WELDS, VOLUME 2 Final Report**
Harold Berger and John H. Smith 18 Oct. 1976 139 p refs
(Contract DOT-AS-70006)
(PB-260401/5; NBSIR-76-1154-Vol-2; DOT/MTB/OPSO-76/03) Avail: NTIS HC A07/MF A01 CSCL 13K

For abstract, see N77-19507.

**N77-19509#** GAI Consultants, Inc., Monroeville, Pa.
**FLY ASH AS A CONSTRUCTION MATERIAL FOR HIGHWAYS. A MANUAL**
James F. Meyers, Raman Pichumani, and Bernadette S. Kapples May 1976 201 p refs
(Contract DOT-FH-11-8801)
(PB-259302/8; FHWA-IP-76-16; Rept-75-524) Avail: NTIS HC A10/MF A01 CSCL 13C

Fly ash is used as embankment or structural backfill material over weak or compressible soils because of the reduced surcharge that results from its light unit weight. In addition, its good shear strength properties result in low compressibility and good stability characteristics. Economies can be realized in the design of retaining structures backfilled with lightweight fly ash. Fly ash improves the flow properties and strength characteristics of grouts. It can be used alone for void-filling, or used in conjunction with Portland cement, lime clay, sand, and gravel to develop grouts for applications related to highway structures. GRA

**N77-19510#** Washington Univ., Seattle. Dept. of Mechanical Engineering.
**DYNAMIC FINITE ELEMENT AND DYNAMIC PHOTOELASTIC ANALYSES OF AN IMPACTED PRETENSIONED PLATE Interim Report**
A. S. Kobayashi, S. Mall, and A. F. Emery Sep. 1976 20 p refs
(Contract N00014-76-C-0060; NR Proj. 064-478)
(AD-A031226; TR-26) Avail: NTIS HC A02/MF A01 CSCL 20/11

Dynamic finite element and dynamic photoelasticity were used to analyze ESSO type fracture toughness specimen machined from Homalite-100 sheets of 9.5mm thickness. Crack velocities determined from photoelasticity experiments were prescribed in the dynamic finite element analysis for the purpose of establishing numerically a dynamic fracture toughness which varies with the crack velocity. Qualitative agreement between dynamic energy release rates determined by the two procedures were found, provided an appropriate impulse was prescribed in the dynamic finite element analysis. The dynamic finite element analysis also provided results with sufficient time resolution to confirm our postulate that K sub d = K sub c at the onset of crack propagation in Homalite-100 plates and that K sub a varies in these test specimens. Author

**N77-19511#** Texas Univ., Austin. Dept. of Aerospace Engineering and Engineering Mechanics.
**A STUDY OF CONVERGENCE AND STABILITY OF FINITE ELEMENT APPROXIMATION OF SHOCK AND ACCELERATION WAVES IN NONLINEAR MATERIALS Final Report, 1 Sep. 1975 - 31 Aug. 1976**
J. Tinsley Oden, L. C. Wellford, Jr., and C. T. Reddy Aug. 1976 303 p refs
(Grant DAAG29-76-G-0022; DA Proj. 1T1-61102-BH-57)
(AD-A031238; ARO-11860.9-M) Avail: NTIS HC A14/MF A01 CSCL 20/11

This report summarizes the recent work on the development of discontinuous finite element methods for the analysis of shock waves in nonlinear elastic materials. A class of one-dimensional finite elements is introduced in which the local interpolation functions consist of the usual piecewise linear functions and some additional functions which have discontinuities. In this way it is possible to model the local displacement field in terms of the values of the displacement at each node and two additional terms in which the shock strength and the location of the shock within an element are used as parameters. The corresponding variational formulation contains the required jump conditions. For a specific class of material, a priori error estimates are derived, and the scheme is implemented and applied to a number of representative examples. Author (GRA)

**N77-19512#** Harry Diamond Labs., Adelphi, Md.
**A NOTE ON FRONT-SURFACE THERMOELASTIC RELAXATION**
Flynn B. McLean Oct. 1976 13 p refs
(DNA Proj. NWED-QAXTB074; HDL Proj. 248623)
(AD-A030342; HDL-TM-76-24) Avail: NTIS HC A02/MF A01 CSCL 20/11

Some recent analytic results for the one-dimensional thermoelastic response of materials exposed to pulsed energy deposition are cast into a form convenient for studying the effects of front-surface relaxation occurring during the exposure time. Numerical calculations are presented for the relaxation as a function of exposure time for several common energy deposition profiles. Author (GRA)

**N77-19513#** California Univ., Berkeley. Div. of Structural Engineering and Structural Mechanics.
**FINITE ELEMENT FORMULATION AND SOLUTION OF CONTACT-IMPACT PROBLEMS IN CONTINUUM MECHANICS, 4**
Thomas J. R. Hughes, Robert L. Taylor, Jerome L. Sackman, and Worsak Kanoknukulchai Jul. 1976 99 p refs
(Contract N68305-75-C-0004)
(AD-A030280; UCSESM-76-4) Avail: NTIS HC A05/MF A01 CSCL 20/11

In Section 1, theory and algorithms for large displacement contact-impact analysis in two dimensions (i.e. plane stress, plane strain and axisymmetric) are presented. The theory encompasses a wide range of contact-impact problems and allows for a completely arbitrary contact surface development, stick, slip and frictional sliding conditions, and impact-release conditions covering the full range of contact possibilities. Section 2 describes some new developments regarding the Hertzian algorithm. Section 3 contains sample problems which employ the algorithms described in Section 1 and also some studies involving the Hertzian algorithm. Anticipating the need for an efficient shell element for crash configuration modelling, the authors have performed a pilot study of a plate bending element. The results of this study, which are encouraging, are contained in Section 4. GRA

**N77-19514#** California Inst. of Tech., Pasadena. Div. of Engineering and Applied Science.

**ON FINITE ANTI-PLANE SHEAR FOR INCOMPRESSIBLE ELASTIC MATERIALS**

James K. Knowles Aug. 1976 30 p refs

(Contract N00014-75-C-0016)

(AD-A029414; TR-36) Avail: NTIS HC A03/MF A01 CSCL 20/11

This paper is concerned with deformations corresponding to anti-plane shear in finite elastostatics. The principal result is a necessary and sufficient condition for a homogeneous, isotropic, incompressible material to admit nontrivial states of anti-plane shear. The condition is given in terms of the strain energy density characteristic of the material and is illustrated by means of special examples. Author (GRA)

**N77-19515#** Brown Univ., Providence, R. I. Lefschetz Center for Dynamical Systems.

**ON THE BEHAVIOR OF LINEAR UNDAMPED ELASTIC SYSTEMS PERTURBED BY FOLLOWER FORCES**

E. F. Infante and J. A. Walker 1976 14 p refs Presented at Intern. Symp. on Dynamical Systems, Gainesville, Fla., Mar. 1976

(Contract N00014-67-A-0191-0009; Grant DAHC04-75-G-0077)

(AD-A030183) Avail: NTIS HC A02/MF A01 CSCL 20/11

This problem, known as Beck's Problem is one of many non-conservative problems encountered in the theory of elastic structures; the problem is called nonconservative in that the total energy is not necessarily constant given the follower nature of the load. In the more familiar Euler problem in which the load p is always in the vertical direction energy is conserved; as is well known, a bifurcation of static solutions occurs at a critical value of p, the so-called Euler static buckling load. No such phenomenon arises in the case of Beck's problem; bifurcation of static solutions does not occur. Rather, as the load p is increased, a critical value is surpassed and certain oscillatory solutions no longer remain bounded; i.e., dynamic instability occurs. This phenomenon has been investigated in the engineering literature through the use of separation of variables and subsequent analysis of the eigenvalues corresponding to the first few eigenvectors. In this manner, a critical value of the load p is determined below which the motions described by these eigenvectors are bounded, whereas for p above this value at least one such motion is unbounded. For Beck's problem, the critical value of p thus obtained is approximately 20.05. Since, in the stable case, all eigenvalues are purely imaginary, such an analysis in not necessarily conclusive. GRA

**N77-19516#** Naval Weapons Center, China Lake, Calif.

**A SHELL-CONTINUUM TRANSITION FINITE ELEMENT**

John W. Onstott Jun. 1976 81 p refs

(AD-A029208; NWC-TP-5876) Avail: NTIS HC A05/MF A01 CSCL 20/11

A finite element analysis procedure for axisymmetric shell problems including regions where shell theory is not applicable is developed. This procedure allows for the analysis of complex shell structures using a combination of shell and elasticity finite elements. A transition element for linking these two incompatible elements is developed. The inclusion of the transition element is accomplished through the addition of a subroutine to an existing finite element program. Example solutions are included to demonstrate the accuracy and utility of the procedure.

Author (GRA)

**N77-19517#** Northwestern Univ., Evanston, Ill. Dept. of Materials Science and Engineering.

**STUDY OF THE PRECISION OF X-RAY STRESS ANALYSIS**

M. R. James and J. B. Cohen 1 Aug. 1976 20 p refs

(Contract N00014-75-C-0580; NR Proj. 031-733)

(AD-A027874; TR-12) Avail: NTIS HC A02/MF A01 CSCL 20/11

Software is described for complete computer control of residual stress measurements. One program (that incorporates either the two tilt method, the sin squared psi procedure, or the Cohen-Marion technique) has been developed for use with either a normal detector or a position sensitive detector. The operator inputs the desired error in stress and various instrumental parameters that determine systematic errors. The counting strategy to obtain the total error is then determined by the software. Employing this automated system, an investigation of a parabolic fit to the top of a diffraction profile indicates that a three point fit is satisfactory only for sharp profiles. Surprisingly, with a standard detector for fixed total time of data accumulation, the sin squared psi procedure gives better precision than the two tilt method. A position sensitive detector system exhibited excellent precision in replicate residual stress measurements. Errors of + or - 6000 psi were obtained on samples having broad diffraction profiles in only 30 seconds. It was also found that sample displacement is less important for stationary slit geometry than with parafocusing technique. Parallel beam geometry shows minimal effects due to sample displacement (as is well known) but precision of the residual stress measurement decreases, because this procedure broadens the diffraction profile. Design parameters for a portable unit based on these results are discussed. This research was supported by the U.S. Office of Naval Research. Author (GRA)

**N77-19518#** Watervliet Arsenal, N.Y.

**EFFECTS OF SUPPORT FLEXIBILITY ON THE STABILITY OF A BEAM UNDER A FOLLOWER THRUST AND INERTIA**

Julian J. Wu Jun. 1976 23 p refs

(DA Proj. 1T1-61101-A-91A)

(AD-A028089; NVT-TR-76024) Avail: NTIS HC A02/MF A01 CSCL 20/11

The stability behavior of a slender structure, modeled by a beam, subjected to a follower force at one end and restrained at the other, is studied in detail in this paper. Denoting rigidities of lateral deflection and of rotation by alpha sub 1 and alpha sub 2 respectively, eigenvalue curves which dictate the stability behavior are plotted for several combinations of parameters alpha sub 1, alpha sub 2 and the magnitude of the thrust. Specifically, the critical loads prior to flutter instability are obtained for the three extreme cases (alpha sub 1 = infinity, alpha sub 2 = infinity), (alpha sub 1 = infinity, alpha sub 2 = 0) and (alpha sub 1 = 0, alpha sub 2 = infinity), together with the case alpha sub 1 = 0, alpha sub 2 = 0) which is unstable at any load due to divergence mode as reported previously. Given a fixed magnitude of thrust, a 'region' of stability or instability can be established in terms of support flexibilities. The increase of rigidity (alpha sub 1 or alpha sub 2) can be stabilizing in one situation and destabilizing in another depending on the amount of the thrust and the relative magnitude of alpha sub 1 and alpha sub 2. These conclusions are illustrated in several sets of curves of various typical combinations of parameters. Author (GRA)

**N77-19519#** Air Force Materials Lab., Wright-Patterson AFB, Ohio. Nonmetallic Materials Div.

**ELASTIC RESPONSE OF ROSETTE CYLINDERS UNDER AXISYMMETRIC LOADING Interim Report, Oct. 1975 - Mar. 1976**

N. J. Pagano Jul. 1976 37 p refs

(AF Proj. 2279)

(AD-A030876; AFML-TR-76-94) Avail: NTIS HC A03/MF A01 CSCL 11/4

The problem of the elastic response of a rosette cylinder, i.e., a cylindrical body formed by reinforced composite layers wrapped along spiral trajectories, is formulated and solved through the application of the theory of heterogeneous elasticity. It is shown that 21 elastic coefficients, which in general, are functions of position in the medium, enter the elastic constitutive equations. Certain geometric preliminaries and tensor transformation laws establish the relation between these coefficients and the orthotropic moduli of the basic sheet material. It is also demonstrated that problems involving axisymmetric boundary conditions can be formulated in terms of one space variable, and this class of boundary value problems is solved through a numerical procedure. Included in the response is the influence of environmental dilation, which may be caused by a uniform temperature change and/or moisture adsorption. An example problem indicates the potential of rosette construction to drastically reduce stress concentration factors and illustrates significant errors

resulting from improper modeling of the material structure.
Author (GRA)

**N77-19520#** Northwestern Univ., Evanston, Ill. Dept. of Materials Science and Engineering.
**THE NEED FOR EXPERIMENTALLY DETERMINED X-RAY ELASTIC CONSTANTS**
R. H. Marion and J. B. Cohen 1 Aug. 1976 16 p refs
(Contract N00014-75-C-0580; NR Proj. 031-733)
(AD-A030616; TR-13) Avail: NTIS HC A02/MF A01 CSCL 11/6

In order to convert residual strains measured by X-ray diffraction techniques into residual stresses, appropriate X-ray elastic constants have to be measured. Snce these X-ray elastic constants may depend on the metallurgical state, deformation, and entire specimen history, errors in stress values may result if the constants are not measured for representative material states. In the present work, it is shown that in some cases these errors may be large. The X-ray elastic constant, (S sub 2)/2 = (1 + nu/E, has been measured for the 211 CrK sub alpha reflection from an Armco iron sample which had been previously deformed by rolling (69 pct. reduction in thickness) and for the 211 CrK sub alpha and 310 CoK sub alpha reflections from a 1045 steel specimen which had been previously elongated in tension. The measured elastic constant for the Armco iron specimen was 40 pct. lower than the value calculated from the average of the Reuss and Voigt values. Author

**N77-19521#** Air Force Flight Dynamics Lab., Wright-Patterson AFB, Ohio.
**PREDICTION OF THE ANGULAR VIBRATION OF AIRCRAFT STRUCTURES Final Report, Sep. 1975 - Jan. 1976**
Jon Lee and P. Wayne Whaley Jun. 1976 34 p refs Presented at AIAA-AFWAL Mini-Symp., Wright-Patterson AFB, Ohio, 25 Mar. 1976
(AF Proj. 1370)
(AD-A031208; AFFDL-TR-76-56) Avail: NTIS HC A03/MF A01 CSCL 01/3

Using the Bernoulli-Euler beam as a theoretical model, qualitative relationships have been developed to predict the angular vibration from a prescribed linear vibration response. Based on laboratory and flight test data, the overall accuracy of predictions is within + or - 20% of the angular vibration measurements. Such a prediction capability may be considered very significant in that the prediction schemes are intended only for qualitative purposes. In addition, due to the difficulties in obtaining accurate angular measurements, the present vibration data are limited to a gross confirmation of predictions. Author (GRA)

**N77-19522#** Stanford Univ., Calif. Systems Optimization Lab.
**OPTIMAL DESIGN OF PITCHED TAPERED LAMINATED WOOD BEAMS**
M. Avriel (Technion - Israel Inst. of Tech.) and J. D. Barrett (Western Forest Products Lab., Vancouver) May 1976 24 p refs
(Contracts N00014-75-C-0267; N00014-75-C-0865; E(04-3)-326PA18; Grant NSF DCR-75-04544; NR Proj. 047-064; NR Proj. 047-143)
(AD-A030689; SOL-76-9) Avail: NTIS HC A02/MF A01 CSCL 13/13

The optimal design of a pitched tapered laminated woood beam is considered. An engineering formulation is given in which the volume of the beam is minimized. The problem is then reformulated and solved as a generalized geometric (signomial) program. Sample designs are presented. Author (GRA)

**N77-19523#** Naval Civil Engineering Lab., Port Hueneme, Calif.
**CONCRETE FOR OCEAN THERMAL ENERGY, CONVERSION STRUCTURES Final Report, Jun. 1975 - Jan. 1976**
H. H. Haynes and R. D. Rail Aug. 1976 51 p refs Sponsored by ERDA
(AD-A031045; CEL-TN-1448) Avail: NTIS HC A04/MF A01 CSCL 10/1

The purpose of this study was to assess the state of the art of concrete technology and construction practices as they are related to the construction of massive floating structures to house ocean thermal energy conversion (OTEC) systems. The relevant capabilities and limitations of available concrete technology and construction practices are described and deficient areas identified. Recommendations for research and development are given by which reasonable improvements can be made in the near term to provide greater assurances of long-term safe and reliable operation of the OTEC systems and to provide lower cost structures. Author (GRA)

**N77-19524#** ENSCO, Inc., Springfield, Va. Transportation and Instrumentation Sciences Div.
**AUTOMATION OF THE SCHONFELD METHOD OF HIGHWAY SURFACE TEXTURE CODE ASSIGNMENT. VOLUME 4: PROFILE CLASSIFICATION TECHNIQUE. PHASE 2 Final Report, Oct. 1975 - Apr. 1976**
E. D. Howerter and T. J. Rudd Apr. 1976 176 p refs Sponsored by Md. State Highway Admin. Prepared in cooperation with FHWA, Washington, D. C.
(PB-259553/6; FHWA-MD-R-76-8D) Avail: NTIS HC A09/MF A01 CSCL 13B

It was demonstrated that the Schonfeld method of surface texture classification could be automated by electronically digitizing stereophotographs of the actual surface and then performing a computer analysis on the digital surface data. However, while it is possible to collect the necessary pavement data on-board a moving vehicle, due to the off-line digitizing and considerable computer processing required, this approach is not readily adaptable for real time implementation. The feasibility of automating the Schonfeld method using considerably less pavement data in the form of single line profiles rather than the complete surface description was also studied. GRA

**N77-19525#** National Bureau of Standards, Boulder, Colo. Cryogenics Div.
**MATERIALS RESEARCH IN SUPPORT OF SUPERCONDUCTING MACHINERY, 5 Semiannual Technical Report, 1 Sep. 1975 - 1 Mar. 1976**
Richard P. Reed, H. M. Ledbetter, and Edward C. VanReuth Apr. 1976 426 p refs Prepared in cooperation with Battelle Columbus Labs., Ohio, and Westinghouse Electric Corp., Pittsburgh
(AD-A030170) Avail: NTIS HC A19/MF A01 CSCL 20/3

The fifth semi-annual technical reports are collected from three subcontractors of an ARPA-sponsored program to study the very low-temperature properties of structural materials in support of the development of superconducting machinery. The program is outlined and new research results are reported. Low-temperature results are given for the following properties: elastic, tensile, fatigue and fracture, thermal expansion, specific heat, thermal and magnetothermal conductivity, electrical and magnetic. Effects of processing and fabrication are also considered for some properties; weld and braze-joint properties are included. Tensile and compressive properties at 4 K of selected composite materials are presented. Author (GRA)

**N77-19526#** Army Engineer Waterways Experiment Station, Vicksburg, Miss.
**COMPACTION STUDY OF ZERO-SLUMP CONCRETE Final Report**
Cecil D. Burns Aug. 1976 20 p refs
(DA Proj. 4K0-78012-AQ-61)
(AD-A030906; WES-MP-S-76-16) Avail: NTIS HC A02/MF A01 CSCL 11/2

Tests were conducted at the U. S. Army Engineer Waterways Experiment Station in September 1975 to determine the effectiveness of vibratory and static compaction rollers in the compaction of zero-slump portland cement concrete pavements. It was determined that heavy vibratory rollers were very effective in compacting the dry-mix concrete and that the strength properties (compressive strength and flexural strength) were somewhat higher than would have been obtained with a conventional mix of the same cement content having a slump in excess of 1 in. The surface smoothness, surface texture, and riding quality of the pavement were considered adequate for wearing surfaces of secondary roads and streets, haul roads, service entrances, tank trails, etc., and as a base for any pavement system. Indications are that considerable cost reductions in the construction of portland cement concrete pavements can be realized by use of dry (zero-slump) concrete mixtures placed

and spread by base course or asphalt spreaders and compacted with heavy vibratory rollers. Author (GRA)

**N77-19527#** Maryland Univ., College Park. Dept. of Civil Engineering.
**FATIGUE STRENGTH OF OVERLOADED BRIDGE COMPONENTS Final Report, Oct. 1973 - Sep. 1975**
Pedro Albrecht, Ali Abtahi, and George R. Irwin Jun. 1976 152 p refs Sponsored in part by Md. State Highway Admin., Brooklandville and the FHWA
(PB-259955/3; FHWA-MD-R-76-7) Avail: NTIS HC A08/MF A01 CSCL 11F

The fatigue behavior of a weldment subjected to periodic overloads was investigated. The three main aspects of this investigation were (1) the experimental determination of the fatigue strength of a welded detail with periodic overloads added to the constant amplitude stress cycling, (2) the application of fracture mechanics concepts to fatigue life prediction of periodically overloaded specimens, and (3) generalization of the results to other types of detail and determination of safe overloading conditions for steel bridges. GRA

# 42 GEOSCIENCES (GENERAL)

**N77-19528#** INTASA, Inc., Menlo Park, Calif.
**ISSUES RELATED TO INTERFACING WATER RESOURCE PLANNING AND LAND USE PLANNING: DEVELOPMENT AND APPLICATION OF QUANTITATIVE PROCEDURES Final Report**
S. Davenport, C. H. Volissaint, W. B. Betchart, J. Rosing, and K. Skurski May 1976 227 p refs
(Contract DI-14-31-0001-5207)
(PB-259331/7; IRP-74-01; W77-00526; OWRT-C-6057(5207)(1)) Avail: NTIS HC A11/MF A01 CSCL 13B

Requirements for interfacing water and land resources planning are discussed. Results include: (1) simplified quantitative procedures based on regional water, land and mass balance relationships and demonstrated in the Platte River, Nebraska Level B regional study; (2) an improved fiscal cost analysis procedure for short term land use decisions based on economic, social and environmental goals, demonstrated in Richmond, Calif.; and (3) extension of site development cost models to analyze housing cost associated with community use policies, demonstrated in Napa, California. GRA

**N77-19529#** ENSCO, Inc., Springfield, Va. Transportation and Instrumentation Sciences Div.
**SUBSURFACE SITE INVESTIGATION BY ELECTROMAGNETIC RADAR. PHASE 1: FEASIBILITY Final Report**
L. A. Rubin, J. N. Griffin, and W. L. Still 31 Mar. 1976 214 p refs Prepared in cooperation with Geophysical Survey Systems, Inc., Burlington, Mass., Underground Technology Development Corp., Alexandria, Va.; and Morrison-Knudsen, Inc., Washington, D. C.
(Grant NSF APR-75-13414)
(PB-259335/8; NSF/RA-760187) Avail: NTIS HC A10/MF A01 CSCL 13B

The use of advanced computer based geophysical techniques, as a supplement to other pre-excavation investigation methods, is studied. This project demonstrated that, with electromagnetic ground-probing radar, geologic structures of interest to subsurface planners produce detectable signals at ranges greater than 25 feet. It was also shown that it is possible to enhance the interpretation of the information in the raw signals through computer signal processing. GRA

**N77-19530#** Advisory Group for Aerospace Research and Development, Paris (France).
**ARTIFICIAL MODIFICATION OF PROPAGATION MEDIA**
H. J. Albrecht, ed. (FGAN, Wachtberg-Werthhoven, Germany) Jan. 1977 189 p refs Conf. Proc. of the Electromagnetic Wave Propagation Panel Specialists' Meeting, Brussels, 26-29 Apr. 1976
(AGARD-CP-192; ISBN-92-835-1234-1) Avail: NTIS HC A09/MF A01

A study concerning the modification of the atmospheric region as a propagation medium is presented. Other areas of discussion were: (1) anthropogeneous changes to non-ionized media, (2) to ionized media by electromagnetic waves, and (3) to ionized media by chemical substances. For individual titles, see N77-19531 through N77-19547.

**N77-19531#** Schule fuer Wehrgeophysik, Fuerstenfeldbruck (West Germany).
**NON-IONISED PROPAGATION MEDIA WITH ARTIFICIALLY MODIFIED PRECIPITATION CHARACTERISTICS c47**
E. Kleinjung *In* AGARD Artificial Modification of Propagation Media Jan. 1977 10 p refs (For primary document see N77-19530 10-42)
Avail: NTIS HC A09/MF A01

Deviations of the meteorological characteristics important for propagation calculations of artificially influenced precipitation and fog are discussed. A comparison is made between the deviations and conditions as they occur in nature. Areas of application are indicated. Author

**N77-19532#** Hamburg Univ. (West Germany). Meteorologisches Inst.
**MAN-MADE MODIFICATION OF CLEAN-AIR PROPAGATION CONDITIONS (VHF TO EHF) c32**
H. Jeske *In* AGARD Artificial Modification of Propagation Media Jan. 1977 5 p refs (For primary document see N77-19530 10-42)
Avail: NTIS HC A09/MF A01

Dispersions of man-made media in the atmosphere (radar chaff, gases, aerosols) or direct modification of the refractive index field, especially characterized by its vertical gradient, ducts and reflecting layers are studied. The use of radar chaff is well defined; other admixtures are less studied under operational conditions. As typical examples for an alteration of the environmental conditions the meteorological situation during large forest fires and the suppression of evaporation by monomolecular films on water surfaces is considered. Above a forest (or other) fire a subnormal refraction layer is formed. The reduction of evaporation diminishes the thickness of the permanent existing evaporation duct over sea and therefore its extensive influence on microwave propagation. The influence of the clear, non-ionized, atmosphere on radio wave propagation some 100 GHz is summarized, and relevant propagation parameters are indentified. Author

**N77-19533#** Siemens A.G., Munich (West Germany).
**REVIEW ON COMMUNICATION ASPECTS OF CHAFF-PRODUCED SCATTER PROPAGATION c32**
E. Lampert *In* AGARD Artificial Modification of Propagation Media Jan. 1977 10 p refs (For primary document see N77-19530 10-42)
Avail: NTIS HC A09/MF A01

With chaff a cloud of many dipoles released into the air communication channels especially for over the horizon links is established. Air communication channels are described, with emphasis placed on the average scatter cross section of the clouds with respect to the length of the dipoles and their distribution in space. The lifetime, fading frequency and coherence bandwidth of the channel are estimated using aerodynamic data from literature. A comparison of the path loss of the chaff channel with that of a troposcatter channel lifetime of the chaff channel is restricted to less than one hour. Author

**N77-19534#** Mainz Univ. (West Germany). Inst. fuer Meteorologie.
**DISCUSSION OF ARTIFICIAL FOG MODIFICATION c47**
Gottfried Haenel *In* AGARD Artificial Modification of Propagation Media Jan. 1977 3 p refs (For primary document see N77-19530 10-42)
Avail: NTIS HC A09/MF A01

Microphysical effects of artificial fog modification are discussed. Budget considerations are included. Fog particles were divided into classes of particles of almost equal size in dry state as well as equal chemical composition and structure in dry state. The total extinction coefficient or absorption coefficient is given

as the sum of the extinction or absorption coefficients of the classes. Author

**N77-19535#** Clermont-Ferrand Univ. (France).
**ARTIFICIAL MODIFICATION OF THE AIR MICROSTRUCTURE INSIDE CLOUDY OR SIMPLY MOIST STRATIFIED LAYERS** **c47**
R. Serpolay, M. Andro (Univ. de Bretagne Occidentale, I.U.T. de Lorient, France), and S. Godard *In* AGARD Artificial Modification of Propagation Media Jan. 1977 13 p refs (For primary document see N77-19530 10-42)
Avail: NTIS HC A09/MF A01

A project in the field of warm fog modification was presented. The method proposed two means; (1) as seeding agent, a polyelectrolyte chemically extracted and prepared from seaweeds; sodium alginate, and (2) for dispersing adequately the chemical finely ground (mean particulate size; 30 micrometers). Results and conclusions are included. Author

**N77-19536#** Office of Telecommunications, Boulder, Colo.
**IONOSPHERIC MODIFICATION INDUCED BY HIGH POWER HF TRANSMITTERS: POTENTIAL FOR COMMUNICATION AND PLASMA PHYSICS RESEARCH** **c46**
W. F. Utlaut *In* AGARD Artificial Modification of Propagation Media Jan. 1977 4 p refs (For primary document see N77-19530 10-42)
Avail: NTIS HC A09/MF A01

High power, HF, ground based radio transmitters were used to intentionally modify the electron temperature and density in the ionosphere since 1970. Transmitting facilities having power aperture products of the order of 10,000 MW M squared were used, and they provided a power density in the F region of a few tens of microwatts per square meter. Observations were obtained using a facility which used an 18 dB1 gain ring array antenna fed with as much as 2MW average power, to produce the ionospheric modification. It was shown that the modified region acts as a significant radio scatterer to radio frequencies at least as high as UHF. It was possible to demonstrate a potential usefulness of ionospheric modification for telecommunication purposes. It was also shown that ionospheric modification and a significantly large scatterer in the ionosphere was produced with relatively low power and simple antennas -- a few hundred kilowatts and dipole antennas. Author

**N77-19537#** Rice Univ., Houston, Tex.
**THE HEATING EXPERIMENT AT ARECIBO** **c46**
W. E. Gordon and H. C. Carlson (Texas Univ. at Dallas, Richardson) *In* AGARD Artificial Modification of Propagation Media Jan. 1977 11 p refs (For primary document see N77-19530 10-42)
Avail: NTIS HC A09/MF A01

The ionized atmosphere over the Arecibo Observatory was illuminated by HF waves in the frequency range 5-12 MHz with an incident power density of 11,000 watts per square meter at the bottom of the ionosphere, resulting in (a) normal absorption producing fractional changes in electron temperature of a few 10's percent near and just below reflection height for O and X modes, and (b) anomalous absorption with plasma waves enhanced by a few orders of magnitude when the frequency of the incident wave matches the local plasma frequency. This condition is achieved for ordinary mode polarization, but the extraordinary wave is reflected in the ionosphere before the matching is achieved. Thus, plasma water instabilities are excited by O-mode waves only. Author

**N77-19538#** White Sands Missile Range, N.Mex.
**A REVIEW OF VHF/UHF SCATTERING FROM A HEATED IONOSPHERIC VOLUME** **c32**
J. Minkoff and I. Weissman *In* AGARD Artificial Modification of Propagation Media Jan. 1977 21 p refs (For primary document see N77-19530 10-42)
Avail: NTIS HC A09/MF A01

It was observed that an ionospheric volume in the F-layer subjected to high power HF illumination becomes an effective scattering medium for radio signals in the VHF/UHF-frequency range. The experimental results are representative of a field-aligned scattering geometry for which the first such observations of VHF/UHF scattering from a heated ionospheric volume are presented. Two distinct and markedly dissimilar scattering modes are observed: center line and plasma line scattering. Center line scattering is observed at the transmitted radar frequency f; plasma line scattering is observed as a pair of sidebands at f + or - F sub H where F sub H is the heater frequency. Center line scattering is highly aspect sensitive with respect to the direction of the geomagnetic field, B; plasma line scattering is bound to be much less aspect sensitive, if at all. By means of bistatic measurements it is determined that center line scattering takes place from field aligned irregularities. The longitudinal scale size of the irregularities, L, is found to be greater than the maximum antenna diameter, 85'. Because of fundamental limitations imposed by the spatial resolution capability of the measurement system no more exact estimate for L is possible. Author

**N77-19539#** Max-Planck-Institut fuer Aeronomie, Lindau Uber Northeim (West Germany).
**ON THE IONOSPHERIC MODIFICATION EXPERIMENT PROJECTED AT MPI LINDAU: SCIENTIFIC OBJECTIVES** **c46**
P. Stubbe and H. Kopka *In* AGARD Artificial Modification of Propagation Media Jan. 1977 11 p refs (For primary document see N77-19530 10-42)
Avail: NTIS HC A09/MF A01

An ionospheric modification experiment to be carried out near Tromso, Norway is described. The scientific objectives include (a) the study of parametric instabilities using the EISCAT incoherent scatter system (b) nonlinear electromagnetic wave propagation effects, in relation to the polar electrojet, (c) determination of certain parameters of aeronomic interest, (d) modification of natural polar electrojet instabilities, and (e) extension of the diagnostic capabilities of the EISCAT incoherent scatter facility. Author

**N77-19540#** Max-Planck-Institut fuer Aeronomie, Lindau Uber Northeim (West Germany).
**ON THE IONOSPHERIC MODIFICATION EXPERIMENT PROJECTED AT MPI LINDAU: PRACTICAL REALIZATION** **c46**
H. Kopka, P. Stubbe, and R. Zwick *In* AGARD Artificial Modification of Propagation Media Jan. 1977 7 p refs (For primary document see N77-19530 10-42)
Avail: NTIS HC A09/MF A01

The technical design of the ionospheric modification experiment is outlined. The heating facility consists of 10 100 kW transmitters, feeding into arrays of 5 x 6 crossed dipoles. There are three such arrays to cover the frequency range 2.75 - 8.00 MHz. Author

**N77-19541#** Stanford Univ., Calif. Radioscience Lab.
**MODIFICATION OF THE PROPAGATION CHARACTERISTICS OF THE IONOSPHERE (AND THE MAGNETOSPHERE) BY INJECTION INTO THE MAGNETOSPHERE OF WHISTLER-MODE WAVES** **c32**
R. A. Helliwell, J. P. Katsufrakis, and P. A. Bernhardt *In* AGARD Artificial Modification of Propagation Media Jan. 1977 8 p refs (For primary document see N77-19530 10-42)
Avail: NTIS HC A09/MF A01

A technique for modifying the electrical properties of the lower ionosphere is described. Electromagnetic waves in the whistler-mode frequency range are used to precipitate energetic electrons into the D and E regions. Advantage is taken of the amplifying properties of the magnetosphere which can increase the power density of a whistler-mode wave by three orders of magnitude. During and after the amplification process, energetic electrons are scattered in pitch angle producing an increase in the particle flux that is absorbed by the ionosphere. Author

**N77-19542*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**LOW FREQUENCY ELECTRIC FIELD VARIATIONS DURING HF TRANSMISSIONS ON A MOTHER-DAUGHTER ROCKET** **c32**
T. J. Rosenberg (Maryland Univ., College Park), M. C. Maynard, J. A. Holtet, N. O. Karlsen, A. Egeland, T. Moe (Bergen Univ., Norway), and J. Troim (Norwegian Defence Res. Estab., Kjeller) *In* AGARD Artificial Modification of Propagation Media Jan. 1977 11 p refs Sponsored by the Royal Norwegian Council for Scientific and Industrial Res. Prepared in cooperation with

Oslo Univ. (For primary document see N77-19530 10-42)
Avail: NTIS HC A09/MF A01

HF wave propagation experiments were conducted on Mother-Daughter rockets in the polar ionosphere. Swept frequency transmissions from the Mother, nominally covering the range from 0.5 to 5 MHz in both CW and pulse modes, are received by the Daughter. In the most recent rocket of the series, the Mother also contained an AC electric field spectrometer covering the frequency range from 10 Hz to 100 kHz in four decade bands. The low frequency response of the ionosphere with respect to waves emitted from the onboard HF transmitter is examined. Author

**N77-19543#** Max-Planck-Institut fuer Extraterrestrische Physik, Garching (West Germany).
**MODIFICATION OF IONIZED MEDIA BY CHEMICAL SUBSTANCES: A REVIEW OF PHYSICAL PROCESSES** **c46**
G. Haerendel *In* AGARD Artificial Modification of Propagation Media Jan. 1977 15 p refs (For primary document see N77-19530 10-42)
Avail: NTIS HC A09/MF A01

Chemical releases and artificial and natural modification processes are briefly surveyed and summarized. Author

**N77-19544#** Boston Univ., Mass. Dept. of Astronomy.
**SPATIAL-TEMPORAL DEVELOPMENT OF MOLECULAR RELEASES CAPABLE OF CREATING LARGE-SCALE F-REGION HOLES** **c46**
Michael Mendillo and Jeffrey M. Forbes (Boston College) *In* AGARD Artificial Modification of Propagation Media Jan. 1977 8 p refs (For primary document see N77-19530 10-42)
(Contract F19628-75-C-0044)
Avail: NTIS HC A09/MF A01

Diffusion in an exponetial atmosphere, with and without chemical loss processes for the diffusing substance, and for a variety of possible release heights and solar cycle conditions is under study. Since the amounts of material capable of injection into the F-region are under most projected circumstances, much less than the 1 ton/second of exhaust ejected by the Saturn V second stage engines during the Skylab launch, a thorough analysis of the diffusion process was done for any prediction of the types of smaller holes which can be created. To a first approximation, the rate of decrease of electrons at any particular time and distance from the release point is proportional to the instantaneous concentration of the diffusing substance. The results for diffusion of molecular hydrogen (one of the highly reactive molecules capable of creating F-region holes) shows that chemical loss by atomic oxygen severely affects the expansion of the released gas by creating a chemical sink in the lower thermosphere which competes with diffusion. Author

**N77-19545*#** Stanford Univ., Calif. Radioscience Lab.
**CHEMICAL DEPLETION OF THE IONOSPHERE** **c46**
P. A. Bernhardt, A. V. DaRosa, and C. G. Park *In* AGARD Artificial Modification of Propagation Media Jan. 1977 16 p refs Sponsored in part by NSF (For primary document see N77-19530 10-42)
(Contract NAS8-31769; Grant NGR-05-020-001)
Avail: NTIS HC A09/MF A01

A theoretical study of the chemical and gas dynamical processes resulting from the release of reactive gases into the daytime ionosphere is discussed. Only point releases, such as from an explosion or a pulsed jet, are considered. Some scientific uses of the artificial reduction of the ionospheric plasma are considered. Author

**N77-19546#** Leicester Univ. (England).
**SOME EFFECTS OF A HIGH ALTITUDE BARIUM RELEASE ON THE PROPAGATION CHARACTERISTICS OF HF RADIOWAVES** **c46**
T. B. Jones and C. T. Spracklen *In* AGARD Artificial Modification of Propagation Media Jan. 1977 7 p refs Sponsored by the Procurement Executive Ministry of Defence (For primary document see N77-19530 10-42)
Avail: NTIS HC A09/MF A01

The effect that the electron density changes produced by the chemical release have on the propagation of HF radiowaves is studied. Some of the disturbances observed during the release of a Barium cloud at a hight of 175 km over the South Uist range in the UK are reported. Author

**N77-19547#** Atomic Weapons Research Establishment, Aldermaston (England).
**MODIFICATION OF THE IONOSPHERE BY BARIUM ION CLOUDS** **c46**
A. J. Baxter *In* AGARD Artificial Modification of Propagation Media Jan. 1977 10 p refs (For primary document see N77-19530 10-42)
Avail: NTIS HC A09/MF A01

The types of approximation used to model the development of ion clouds are discussed, and reference is made to the ionospheric parameters that were extracted from the experiments. An ion cloud was viewed directly up the geomagnetic field lines. The characteristics of the ion cloud as it passed through its development phases are quite marked and an interruption to the propagation path of a subsidiary experiment was observed at the time of the onset of structure in the barium cloud. The optical observations are discussed and conclusions made on the form of ionospheric model that was used to describe the phenomena. Perfect coupling to the E layer was explored. Author

# 43 EARTH RESOURCES

Includes remote sensing of earth resources by aircraft and spacecraft; photogrammetry; and aerial photography.

For instrumentation see *35 Instrumentation and Photography*.

**N77-19548*+** National Aeronautics and Space Administration, Washington, D.C.
**EARTH RESOURCES: A CONTINUING BIBLIOGRAPHY WITH INDEXES, ISSUE 11, OCTOBER 1976**
Oct. 1976 162 p
(NASA-SP-7041(11)) Avail: NTIS HC E05 CSCL 05B

This bibliography lists 714 reports, articles, and other documents introduced into the NASA scientific and technical information system between July 1976 and September 1976. Emphasis is placed on the use of remote sensing and geophysical instrumentation in spacecraft and aircraft to survey and inventory natural resources and urban areas. Subject matter is grouped according to agriculture and forestry, environmental changes and cultural resources, geodesy and cartography, geology and mineral resources, hydrology and water management, data processing and distribution systems, instrumentation and sensors, and economic analysis. Author

**N77-19549*#** Department of Agricultural Technical Services, Pretoria (South Africa). Botanical Research Inst.
**MONITORING THE EXTENT AND OCCURENCE OF FIRE IN THE DIFFERENT VELD TYPES OF SOUTH AFRICA WITH PARTICULAR REFERENCE TO IT'S ECOLOGICAL ROLE**
**Quarterly Progress Report**
Denzil Edwards, Principal Investigator 5 Sep. 1976 18 p Sponsored by NASA ERTS
(E77-10106; NASA-CR-149592; QPR-4) Avail: NTIS HC A02/MF A01 CSCL 08F

The author has identified the following significant results. Imagery showed the highest amount of burned area to be in the western, southern, and eastern Transvaal and in one scene of the Transkei coast region. The percentage of burned area per image in all instances exceeded 1.4% reaching a maximum of 8.24% equivalent to 121,758 ha out of 1,476,540 ha of one image in the eastern Transvaal lowveld. There was a consistent increase in the amount of burnt area on images from July through to the end of October. From October onwards, there was a decrease in burned area so that during December there was none or very little burning evident. Four scenes comprising nine images showed burning according to the twelve veld types. Considerable variation was evident in the burning between different veld types: between 10 and 19% of the mixed, sourish-mixed, and sour bushveld types was burnt, but in other veld types the percentage of burnt area was less than 1%.

**N77-19550*#** Pennsylvania State Univ., University Park. Office for Remote Sensing of Earth Resources.
**TECHNIQUES FOR DELINEATION AND PORTRAYAL OF LAND COVER TYPES USING ERTS-1 DATA Interim Report**
George J. McMurtry, Gary W. Petersen, Principal Investigators, and A. D. Wilson Dec. 1974 18 p Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS
(Contract NAS5-23133)
(E77-10110; NASA-CR-149597; ORSER-SSEL-TR-23-74) Avail: NTIS HC A02/MF A01 CSCL 08F

The author has identified the following significant results. ERTS data were used to map land cover in agricultural areas, although in some parts of Pennsylvania, with small irregular fields, many of the pixels overlap field boundaries and cause difficulties in classification. Various techniques and devices were used to display the results of these land cover analyses. The most promising approach would be a user-interactive color monitor interfaced with a large computer so that classification results could be displayed on the CRT and these results output by a hard complete copier.

**N77-19551*#** Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
**LANDSAT APPLICATION OF REMOTE SENSING TO SHORELINE-FORM ANALYSIS Quarterly Report, 1 Jan. - 1 Mar. 1977**
Robert Dolan, Bruce Hayden, and Jeffrey Heywood, Principal Investigators 16 Mar. 1977 12 p refs ERTS
(Contract NAS5-20999)
(E77-10112; NASA-CR-149561) Avail: NTIS HC A02/MF A01 CSCL 08C

The author has identified the following significant results. Correlations for 55 segments were quite low, showing few values greater than .6. Most of the correlations substantially increased when they were run for the breakdown of Assateague into eight coastal segments. Some of these correlations reflect strong and important relationships. The correlations between coastal orientation and the standard deviation of rate of shoreline erosion is .93 at the .01 level of significance. Other significant relationships were orientation and swash slope (.84); standard deviation of erosion and subaerial beach slope a(-.79); foredune height and subaerial beach width (-.89); foredune height and mean plus standard deviation of erosion (-.81); and rate of erosion over time and subaerial beach width (.72). Low correlation was found between sand grain size and erosion and between sand grain size and orientation.

**N77-19552*#** National Research Council, Bangkok (Thailand).
**THE PRELIMINARY STUDY OF SKYLAB IMAGERY Final Report, Apr. 1974 - Oct. 1976**
Sanga Sabhasri, Principal Investigator, Darasri Srisaengthong, and Krongsin Boonboothara Oct. 1976 55 p Sponsored by NASA Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS
(E77-10119; NASA-CR-151144; G-28080) Avail: NTIS HC A04/MF A01 CSCL 05B

There are no author-identified significant results in this report.

**N77-19553*#** Kansas Univ. Center for Research, Inc., Lawrence. Remote Sensing Lab.
**SEASONAL VARIATIONS OF THE MICROWAVE SCATTERING PROPERTIES OF DECIDUOUS TREES AS MEASURED IN THE 1-18 GHz SPECTRAL RANGE**
Fawwaz T. Ulaby, Principal Investigator, T. Bush, T. Metzler, and H. Stiles Jun. 1976 47 p refs EREP
(Contract NAS9-10261)
(E77-10120; NASA-CR-151174; RSL-TR-177-60) Avail: NTIS HC A03/MF A01 CSCL 20N

The author has identified the following significant results. Employing two FM-CW radar spectrometers, scattering data were acquired from stands of deciduous trees during the spring and autumn. The data suggest that the trees act as a volume scatter target particularly in the 7-18 GHz region. A comparison of data collected in spring and autumn indicates that the radar scattering coefficient, sigma deg, as measured in spring can be substantially larger (as much as 10 dB) than sigma deg as measured in the autumn.

**N77-19554*#** Department of Agriculture, Washington, D.C. Statistical Reporting Service.
**AREA SAMPLING FRAME CONSTRUCTION FOR AN AGRICULTURE INFORMATION SYSTEM WITH LANDSAT 2 DATA Progress Report, Aug. 1976 - Feb. 1977**
William H. Wigton, Principal Investigator Feb. 1977 3 p Sponsored by NASA ERTS
(E77-10121; NASA-CR-149865) Avail: NTIS HC A02/MF A01 CSCL 05B

There are no author-identified significant results in this report.

**N77-19555*#** Food and Agriculture Organization of the United Nations, Rome (Italy).
**THE APPLICATION OF ERTS IMAGERY TO THE FAO/UNESCO SOIL MAP OF THE WORLD Quarterly Progress Report**
Raoul Dudal and Andre J. Pecrot, Principal Investigators 25 Feb. 1977 6 p ref Sponsored by NASA ERTS
(E77-10122; NASA-CR-149866) Avail: NTIS HC A02/MF A01 CSCL 08G

There are no author-identified significant results in this report.

**N77-19556*#** Geological Survey, Reston, Va.
**APPLICATIONS OF SKYLAB DATA TO LAND USE AND CLIMATOLOGICAL ANALYSIS Final Report**
Robert H. Alexander, Principal Investigator, John E. Lewis, Jr., Harry F. Lins, Jr., Carol B. Jenner, Sam I. Outcalt, and Robert W. Pease Feb. 1976 237 p refs Original contains color imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 EREP
(NASA Order T-5290-B)
(E77-10123; NASA-CR-151196) Avail: NTIS HC A11/MF A01 CSCL 05B

The author has identified the following significant results. Skylab study in Central Atlantic Regional Ecological Test Site encompassed two separate but related tasks: (1) evaluation of photographic sensors S190A and B as sources of land use data for planning and managing land resources in major metropolitan regions, and (2) evaluation of the multispectral scanner S192 used in conjunction with associated data and analytical techniques as a data source on urban climates and the surface energy balance. Photographs from the Skylab S190B earth terrain camera were of greatest interest in the land use analysis task; they were of sufficiently high resolution to identify and map many level 2 and 3 land use categories. After being corrected to allow for atmosphere effects, output from thermal and visible bands of the S192 was employed in constructing computer map plots of albedo and surface temperature.

**N77-19557*#** Purdue Univ., Lafayette, Ind. Lab. for Applications of Remote Sensing.
**THE APPLICATION OF REMOTE SENSING TECHNOLOGY TO THE SOLUTION OF PROBLEMS IN THE MANAGEMENT OF RESOURCES IN INDIANA Semiannual Report, 1 Jun. - 30 Nov. 1976**
R. A. Weismiller, Principal Investigator and R. P. Mroczynski 1977 71 p refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S.D. 57198 ERTS
(Grant NGL-15-005-186)
(E77-10124; NASA-CR-149867) Avail: NTIS HC A04/MF A01 CSCL 05A

The author has identified the following significant results. The Lydich quadrangle area was successfully classified into seven cover types: (1) trees, (2) poorly drained soil and water, (3) pasture land, (4) well drained brown soil, (5) moderately well drained dark brown soil, (6) moderately drained soil, and (7) medium to poorly drained soil. Measurements of the percent of mapping unit represented by a named soil series range from

44 to 55 percent. If the class identified as vegetation is combined with the named unit, the range increases from 54 to 64 percent. The Xenia mapping unit was the only unit represented by less than 50 percent of the named unit. Results from the intensive tent moth study in Owensburg and Williams were interpreted from 70 mm color infrared and visually transferred to maps. A correction factor was necessary, because the date the sample photography was taken was a month later than the intensive site data (CF x acres defoliated in each level = expanded defoliated acres).

**N77-19558*#** Alabama Univ., University. Dept. of Geology and Geography.
**USE OF REMOTE SENSING TECHNIQUES FOR GEOLOGICAL HAZARD SURVEYS IN VEGETATED URBAN REGIONS Final Report, 1 Jul. 1973 - 30 Jun. 1976**
Stephen H. Stow, Rex C. Price, Fred Hoehner, and Charles Wielchowsky Jun. 1976 170 p refs
(Contract NAS8-29937)
(NASA-CR-150196) Avail: NTIS HC A08/MF A01 CSCL 08G

The feasibility of using aerial photography for lithologic differentiation in a heavily vegetated region is investigated using multispectral imagery obtained from LANDSAT satellite and aircraft-borne photography. Delineating and mapping of localized vegetal zones can be accomplished by the use of remote sensing because a difference in morphology and physiology results in different natural reflectances or signatures. An investigation was made to show that these local plant zones are affected by altitude, topography, weathering, and gullying; but are controlled by lithology. Therefore, maps outlining local plant zones were used as a basis for lithologic map construction. Author

**N77-19559*#** Alabama Univ., University. Dept. of Geology and Geography.
**DELINEATION OF GEOLOGICAL PROBLEMS FOR USE IN URBAN PLANNING Final Report, 1 Jul. 1973 - 30 Jun. 1976**
Travis H. Hughes, Pamela Bloss, Robert Fambrough, Stephen H. Stow, W. Gary Hooks, Douglas Freehafer, and David Sutley Jun. 1976 104 p refs
(Contract NAS8-29937)
(NASA-CR-150197) Avail: NTIS HC A06/MF A01 CSCL 08G

Activities of the University of Alabama in support of state and local planning commissions are reported. Demonstrations were given of the various types of remotely sensed images available from U-2, Skylab, and LANDSAT; and their uses and limitations were discussed. Techniques to be used in determining flood prone areas were provided for environmental studies. A rapid, inexpensive method for study was developed by which imagery is copied on 35 mm film and projected on existing topographic maps for measuring delta volume and growth.
Author

**N77-19560*#** TRW Defense and Space Systems Group, Redondo Beach, Calif.
**MONITORING AIR POLLUTION FROM SATELLITES (MAPS). VOLUME 1: TECHNICAL REPORT Final Report, Dec. 1974 - May 1976**
1 Mar. 1977 309 p refs 2 Vol.
(Contract NAS1-13635)
(NASA-CR-145137; TRW-25435-6001-RU-00-Vol-1) Avail: NTIS HC A14/MF A01 CSCL 14B

Performance tests on an electro-optical model of an infrared sensor for remote measurements of trace atmospheric gases are detailed; the instrument utilized a sample of the gas to be measured as spectral filter. Also reported is the development of radiometric calibration equipment that determines responses to simulated pollution effects. Results show excellent agreement with theoretical performance predictions with the exception of nonuniform radiance responses. Balance stability to an accuracy better than the rms noise level was demonstrated for the EOM in both the NH3 and CO modes for a period of two days under laboratory conditions. Flight test results show that the temperature range of the absorption cell is restricted to 255 K or higher.
G.G.

**N77-19561*#** TRW Defense and Space Systems Group, Redondo Beach, Calif.
**MONITORING AIR POLLUTION FROM SATELLITES (MAPS). VOLUME 2: APPENDICES Final Report**
1 Mar. 1977 411 p
(Contract NAS1-13635)
(NASA-CR-145137-Vol-2; TRW-25435-6001-RU-00-Vol-2) Avail: NTIS HC A18/MF A01 CSCL 14B
For abstract, see N77-19560.

**N77-19562*#** Massachusetts Inst. of Tech., Cambridge. Center for Policy Alternatives.
**POLICY ISSUES AND DATA COMMUNICATIONS FOR NASA EARTH OBSERVATION MISSIONS UNTIL 1985**
Arthur B. Corte and Colin J. Warren Nov. 1975 97 p Sponsored by NASA
(NASA-CR-149803) Avail: NTIS HC A05/MF A01 CSCL 05B

The series of LANDSAT sensors with the highest potential data rates of the missions were examined. An examination of LANDSAT imagery uses shows that relatively few require transmission of the full resolution data on a repetitive quasi real time basis. Accuracy of global crop size forecasting can possibly be improved through information derived from LANDSAT imagery. A current forecasting experiment uses the imagery for crop area estimation only, yield being derived from other data sources.
Author

**N77-19563*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**SELECTING RECONNAISSANCE STRATEGIES FOR FLOODPLAIN SURVEYS**
S. C. Sollers, A. Rango, and D. L. Henninger Jan. 1977 45 p refs Submitted for publication
(NASA-TM-X-71273; X-913-77-4) Avail: NTIS HC A03/MF A01 CSCL 08H

Multispectral aircraft and satellite data over the West Branch of the Susquehanna River were analyzed to evaluate potential contributions of remote sensing to flood-plain surveys. Multispectral digital classifications of land cover features indicative of floodplain areas were used by interpreters to locate various floodprone area boundaries. The digital approach permitted LANDSAT results to be displayed at 1:24,000 scale and aircraft results at even larger scales. Results indicate that remote sensing techniques can delineate floodprone areas more easily in agricultural and limited development areas as opposed to areas covered by a heavy forest canopy. At this time it appears that the remote sensing data would be best used as a form of preliminary planning information or as an internal check on previous or ongoing floodplain studies. In addition, the remote sensing techniques can assist in effectively monitoring floodplain activities after a community enters into the National Flood Insurance Program.
Author

**N77-19564*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**SOIL MOISTURE SENSING WITH AIRCRAFT OBSERVATIONS OF THE DIURNAL RANGE OF SURFACE TEMPERATURE**
T. Schmugge, B. Blanchard (Tex. A&M Univ.), A. Anderson, and V. Wang (Lockheed Elec. Co., Inc., Houston) Jan. 1977 23 p refs
(NASA-TM-X-71274; X-913-77-13) Avail: NTIS HC A02/MF A01 CSCL 08H

Aircraft observations of the surface temperature were made by measurements of the thermal emission in the 8-14 micrometers band over agricultural fields around Phoenix, Arizona. The diurnal range of these surface temperature measurements were well correlated with the ground measurement of soil moisture in the 0-2 cm layer. The surface temperature observations for vegetated fields were found to be within 1 or 2 C of the ambient air temperature indicating no moisture stress. These results indicate that for clear atmospheric conditions remotely sensed surface temperatures are a reliable indicator of soil moisture conditions and crop status.
Author

**N77-19565*#** Martin Marietta Corp., Denver, Colo.
**A PRELIMINARY EXPERIMENT DEFINITION FOR VIDEO**

**LANDMARK ACQUISITION AND TRACKING**
Roger T. Schappell, John C. Tietz, Roland L. Hulstrom, Robert A. Cunningham, and Gwynn M. Reel Dec. 1976 83 p refs (Contract NAS1-14489)
(NASA-CR-145122) Avail: NTIS HC A05/MF A01 CSCL 05B

Six scientific objectives/experiments were derived which consisted of agriculture/forestry/range resources, land use, geology/mineral resources, water resources, marine resources and environmental surveys. Computer calculations were then made of the spectral radiance signature of each of 25 candidate targets as seen by a satellite sensor system. An imaging system capable of recognizing, acquiring and tracking specific generic type surface features was defined. A preliminary experiment definition and design of a video Landmark Acquisition and Tracking system is given. This device will search a 10-mile swath while orbiting the earth, looking for land/water interfaces such as coastlines and rivers. Author

**N77-19566#** Battelle Pacific Northwest Labs., Richland, Wash.
**PARTIALLY-SATURATED TRANSIENT GROUNDWATER FLOW MODEL THEORY AND NUMERICAL IMPLEMENTATION**
A. E. Reisenauer (Wash. State Univ.), D. B. Cearlock (Wash. State Univ.), and C. A. Bryan (Mont. Univ.) 1975 39 p refs (Contract AT(45-1)-2130)
(BNWL-1713) Avail: NTIS HC A03/MF A01

The fundamental equations and assumptions applying to the model are discussed. Problems encountered in modeling the flow in soils with water content less than saturation are also delineated. Because of the nonlinearities of the descriptive equations, finite difference approximation and an iterative technique were used to obtain solutions. The model, when tested, was computationally slow and impractical as a management tool but did demonstrate that the equation could be solved for flow entering relatively dry soils. Several methods of dealing with the sediment hydraulic characteristics were tested. ERA

**N77-19567*#** Army Cold Regions Research and Engineering Lab., Hanover, N.H.
**SKYLAB IMAGERY: APPLICATION RESERVOIR MANAGEMENT IN NEW ENGLAND Final Report, Apr. 1973 - Sep. 1975**
H. L. McKim, L. W. Gatto, C. J. Merry, and R. K. Haugen Sep. 1976 58 p refs
(NASA Order T-4646-B)
(NASA-CR-149794; AD-A030329; CRREL-SR-76-7) Avail: NTIS HC A04/MF A01 CSCL 08/8

The purpose of this investigation was to determine the utility of Skylab S190A and B photography for providing reservoir management information in New England. LANDSAT, Skylab S190A and S190B and RB75/RC8 images were reduced to a common scale of 1:63,360 for a mapping base to demonstrate the extent to which the imagery could be utilized in the preparation of reconnaissance land use maps. These types of maps are required in the baseline evaluation of areas for reservoir management planning and for future environmental planning activities, i.e. permit evaluation and impact statements. Visual intepretations were accomplished on orginal NASA color infrared S190A/B and RB57/RC8 transparencies and a LANDSAT false color print made in-house. Ancillary data were not used during the mapping exercise to eliminate bias in the comparisons and to ensure the results were derived strictly from interpretations of tones and textures on the photography. Significant findings of this investigation were as follows: (1) S190B imagery is superior to the LANDSAT MSS imagery for land use mapping and is as useful for category I and II land use mapping as the high altitude RC8 imagery. Detailed land use mapping at levels III and finer from satellite imagery requires better resolution. However, the larger areal coverage available from the S190B imagery is a great advantage. Thus the S190B imagery was found to be nearly ideal for detailed, regional land use mapping. (2) For evaluating volume runoff potentials the S190B imagery was found to be as useful as the RB-57/RC8 imagery. GRA

**N77-19568#** Army Engineer Topographic Labs., Fort Belvoir, Va.
**IMAGE CORRELATION ON A PARALLEL PROCESSOR**
David L. Ackerman, Michael A. Crombie, and Mary L. Powers Jul. 1976 28 p refs
(AD-A030636; ETL-0061) Avail: NTIS HC A03/MF A01 CSCL 08/2

Digital photogrammetry requires that conjugate imagery be located by image correlation. Image correlation involves many computations and can be the most time consuming part of the digital photogrammetry process. This report, in line and area correlations, investigates the feasibility of performing the image correlation calculations on a parallel processor. Line correlation involves searching along epipolar lines using a one-dimensional window of gray shades. Area correlation pertains to using a two-dimensional window of gray shades to search for a match point either over an area or along a specific epipolar line. Functions include the linear correlation coefficient, the covariance, and the sums of absolute differences. The computer programs in this report were written for the GAC STARAN at ETL. The parallel processor may not reach the speeds of a special-purpose, hard-wired correlator, but it has the advantage of being readily reprogrammed. The parallel processor will be used in the interactive digital image processing facility at ETL. Author (GRA)

**N77-19569#** Stanford Research Inst., Menlo Park, Calif.
**REMOTE MEASUREMENT OF AIR POLLUTANTS Annual Progress Report, 1 Jan. - 31 Dec. 1975**
E. R. Murray and R. L. Byer Feb. 1976 56 p refs
(Grant NSF AEN-73-10596-A01; SRI Proj. 2687)
(PB-259975/1; NSF/RANN/IT/AEN73-10596/PR-75; NSF/RA-760253; APR-3) Avail: NTIS HC A04/MF A01 CSCL 14B

Variations in atmospheric scintillation and aerosol scattering are measured and found to be small for the experimental conditions. Heterodyne receivers have been studied and found to be capable of significantly increasing system range and sensitivity. The major effort is toward the completion of the high-energy tunable source for remote monitoring of air pollutants. The receiving telescope is being installed at the end of the year, and the processing electronics are almost completed in preparation for air-pollution sensing experiments. GRA

**N77-19570#** Geological Survey, Albany, N.Y. Water Resources Div.
**WATER RESOURCES DATA FOR NEW YORK, WATER YEAR, 1975 Annual Report, 1 Oct. 1974 - 30 Sep. 1975**
Jun. 1976 755 p refs Sponsored in part by N. Y. State Dept. of Environ. Conservation, Albany, and Corps of Engr., Washington, D. C.
(PB-256669/3; USGS/WRD/HD-76/029; USGS/WDR/Ny-75/1; Rept-1) Avail: NTIS HC A99/MF A01 CSCL 13B

Records of surface water, water quality, and ground water are presented. The surface-water section contains discharge data for 209 gaging stations, stage-content data for 39 take and reservoir stations, and stage-only data for 31 stations; also included are discharge data for 174 partial-record stations and 199 miscellaneous sites. The water-quality section contains chemical, temperature, and suspended-sediment data on surface water for 151 stations, 81 partial-record stations, and 113 miscellaneous sites, as well as chemical data for 233 ground-water miscellaneous sites and 10 precipitation-quality stations. The ground-water section contains water-level data for 42 long-term observation wells. GRA

## 44 ENERGY PRODUCTION AND CONVERSION

Includes specific energy conversion systems, e.g., fuel cells and batteries; global sources of energy; fossil fuels; geophysical conversion; hydroelectric power; and wind power.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power, 28 Propellants and Fuels,* and *85 Urban Technology and Transportation.*

**N77-19571*** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**SOLAR CELL ASSEMBLY Patent**
Henry W. Brandhorst, Jr., inventor (to NASA) Issued 2 Nov. 1976 5 p Filed 30 Sep. 1974 Supersedes N74-33484 (12 - 23, p 2775)
(NASA-Case-LEW-11549-1; US-Patent-3,989,541; US-Patent-Appl-SN-510677; US-Patent-Class-136-89) Avail: US Patent Office CSCL 10A

The solar cell assembly includes a solar cell having an overlay of a semi-transparent coating of a metal, such as aluminum or silver, which covers the entire surface thereof. The purpose of the coating is to lower the amount of incident radiation on the cell and thereby lower cell temperature. The use of the semi-transparent coating over the entire cell surface uniformly limits incident radiation and hence reduces cell heat without any temperature gradients. The coating also lowers series cell resistance. The coating may be directly deposited on the cell surface or on the undersurface of a cover plate bonded to the cell. Official Gazette of the U.S. Patent Office

**N77-19572*#** Boeing Co., Seattle, Wash.
**THE CADMIUM ELECTRODE: REVIEW OF THE STATUS OF RESEARCH**
Sidney Gross and Robert J. Glockling Sep. 1976 163 p refs Prepared for JPL
(Contracts NAS7-100; JPL-953984)
(NASA-CR-149860; D180-19046-2) Avail: NTIS HC A08/MF A01 CSCL 10C

Investigations characterizing the negative cadmium electrode used in a nickel cadmium battery cell are summarized with citations to references where more detailed information is available. Emphasis is placed on data pertinent to aerospace applications. An evaluation of some of the published results of cadmium electrode research is included. Author

**N77-19573*#** Optical Coating Lab., Inc., City of Industry, Calif. Photoelectronics Div.
**RESEARCH, DEVELOPMENT AND PILOT PRODUCTION OF HIGH OUTPUT THIN SILICON SOLAR CELLS Final Report**
P. A. Iles [1976] 38 p Prepared for JPL
(Contracts NAS7-100; JPL-954197)
(NASA-CR-149858) Avail: NTIS HC A03/MF A01 CSCL 10A

Work was performed to define and apply processes which could lead to high output from thin (2-8 mils) silicon solar cells. The overall problems are outlined, and two satisfactory process sequences were developed. These sequences led to good output cells in the thickness range to just below 4 mils; although the initial contract scope was reduced, one of these sequences proved capable of operating beyond a pilot line level, to yield good quality 4-6 mil cells of high output. Author

**N77-19574*#** Scientific Translation Service, Santa Barbara, Calif.
**STORAGE OF THERMAL ENERGY IN MOLTEN SALTS AND METALS**
A. Horsthemke and E. Marschall Washington NASA Mar. 1977 20 p refs Transl. into ENGLISH from Brennstoff-Waerme-Kraft (Duesseldorf), v. 28, Jan. 1976 p 18-22
(Contract NASw-2791)
(NASA-TT-F-17412) Avail: NTIS HC A02/MF A01 CSCL 10C

The investigation is concerned with the characteristic properties of a thermal storage system for an operational temperature range from 500 to 800 C, taking into account the conclusions under which a continuous withdrawal of energy at a constant thermal flow density is possible. The mathematical description of an individual storage element is possible. The mathematical description of an individual storage element is considered. The storage element consists of a double-walled tube. The space between the external and the internal wall is occupied by the storage medium. The supply of heat will generally take place at the external tube wall, and the heat will be withdrawn from the interior tube. However, an operation under reversed conditions is also possible. Attention is given to an analytic solution, a numerical solution and an evaluation of the results of the study. Author

**N77-19575*#** TRW Systems, Redondo Beach, Calif.
**A STUDY OF GEOTHERMAL PROSPECTS IN THE WESTERN UNITED STATES Final Report**
20 Aug. 1975 148 p refs
(Contracts NAS7-100; JPL-954243)
(NASA-CR-149812; TRW-28455-6001-RU-00) Avail: NTIS HC A07/MF A01 CSCL 10B

The commercial development potential of 13 underdeveloped geothermal prospects in the Western United States was examined, and the prospects were ranked in order of relative potential for development on the basis of investment considerations. The following were considered in the ranking: geotechnical and engineering data, energy market accessibility, administrative constraints, and environmental and socio-economic factors. The primary ranking criterion is the unit cost of energy production expected from each prospect. Secondary criteria are administrative constraints, environmental factors and the quality of the geotechnical data. Author

**N77-19576*#** International Business Machines Corp., Yorktown Heights, N.Y. Research Lab.
**OPTIMIZATION OF SOLAR CELLS FOR AIR MASS ZERO OPERATION AND A STUDY OF SOLAR CELLS AT HIGH TEMPERATURES, PHASE 2 Final Report, 20 Jan. 1975 - 1 Mar. 1976**
H. Hovel and J. M. Woodall 1 Mar. 1976 36 p refs
(Contract NAS1-12812)
(NASA-CR-145134) Avail: NTIS HC A03/MF A01 CSCL 10A

Crystal growth procedures, fabrication techniques, and theoretical analysis were developed in order to make GaAlAs-GaAs solar cell structures which exhibit high performance at air mass 0 illumination and high temperature conditions. Author

**N77-19577*#** New Mexico Univ., Albuquerque.
**HYDROGEN ENERGY: A BIBLIOGRAPHY WITH ABSTRACTS. FOURTH QUARTER 1976**
31 Dec. 1976 39 p Sponsored by NASA
(NASA-CR-149864) Avail: Issuing Activity CSCL 16B

A bibliography for the 4th qtr. 1976 is presented. Approximately 112 abstracts are listed. Subject and author indexes are included. L.S.

**N77-19578*#** New Mexico Univ., Albuquerque.
**HYDROGEN ENERGY: A BIBLIOGRAPHY WITH ABSTRACTS. THIRD QUARTER 1976**
30 Dec. 1976 75 p Sponsored by NASA
(NASA-CR-149863) Avail: Issuing Activity CSCL 10B
For abstract, see N77-19577.

**N77-19579*#** National Aeronautics and Space Administration. Pasadena Office, Calif.
**A NON-TRACKING SOLAR ENERGY COLLECTOR SYSTEM Patent Application**
M. Kudret Selcuk, inventor (to NASA) (JPL) Filed 2 Mar. 1977 17 p
(Contract NAS7-100)
(NASA-Case-NPO-13813-1; NASA-Case-NPO-13914-1; US-Patent-Appl-SN-765139) Avail: NTIS HC A02/MF A01 CSCL 10A

A solar energy collector system is described in which an improved concentrator is used for directing incident rays of solar energy on parallel vacuum-jacketed receivers or absorbers. A plurality of individually mounted reflector modules of a common asymmetrical triangular cross-sectional configuration are supported for independent reorientation. A plurality of asymmetric vee trough concentrators is defined. NASA

**N77-19580*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**SYNCHRONIZATION OF THE ERDA-NASA 100 LkW WIND TURBINE GENERATOR WITH LARGE UTILITY NETWORKS**
H. H. Hwang and Leonard J. Gilbert Jul. 1977 17 p refs Presented at the Control of Power Systems Conf., College Station,

Tex., 14-16 Mar. 1977; sponsored by IEEE
(NASA-TM-X-73613; E-9096) Avail: NTIS HC A02/MF A01 CSCL 10B

The synchronizing of a wind turbine generator against an infinite bus under random conditions is studied. With a digital computer, complete solutions for rotor speed, generator power angle, electromagnetic torque, wind turbine torque, wind turbine blade pitch angle, and armature current are obtained and presented by graphs. Author

**N77-19581*#** National Aeronautics and Space Administration. Pasadena Office, Calif.
**DUAL MEMBRANE, HOLLOW FIBER FUEL CELL Patent Application**
John D. Ingham (JPL) and Daniel D. Lawson, inventors (to NASA) (JPL) Filed 3 Feb. 1977 12 p
(Contract NAS7-100)
(NASA-Case-NPO-13732-1; US-Patent-Appl-SN-765138) Avail: NTIS HC A02/MF A01 CSCL 10A

A gaseous fuel cell is described which includes a pair of electrodes formed by open ended, ion-exchange hollow fibers, each having a layer of metal catalyst deposited on the inner surface thereof and large surface area current collectors such as braided metal mesh in contact with the metal catalyst layer. A fuel cell results when the electrodes are immersed in electrolyte and electrically connected. As hydrogen and oxygen flow through the bore of the fibers oxidation and reduction reactions develop an electrical potential. Because the hollow fiber configuration provides large electrode area per unit volume and intimate contact between fuel and oxidizer at the interface, and because of the low internal resistance of the electrolyte, high power densities can be obtained. NASA

**N77-19582*#** Keller and Gannon, San Francisco, Calif.
**ENERGY CONSERVATION AND ANALYSIS AND EVALUATION**
Apr. 1976 67 p
(Contract NASw-2917)
(NASA-CR-149868) Avail: NTIS HC A04/MF A01 CSCL 10B

The survey assembled and made recommendations directed at conserving utilities and reducing the use of energy at the Slidell Computer Complex. Specific items included were: (1) scheduling and controlling the use of gas and electricity, (2) building modifications to reduce energy, (3) replacement of old, inefficient equipment, (4) modifications to control systems, (5) evaluations of economizer cycles in HVAC systems, and (6) corrective settings for thermostats, ductstats, and other temperature and pressure control devices. Author

**N77-19583#** Battelle Pacific Northwest Labs., Richland, Wash.
**POTENTIAL NATIONAL BENEFITS OF GEOTHERMAL ELECTRICAL ENERGY PRODUCTION FROM HYDROTHERMAL RESOURCES IN THE WEST**
C. H. Bloomster and R. L. Engel 1976 22 p refs Presented at the 11th Intersoc. Energy Conversion Engineering Conf., State Line, Nev., 12 Sep. 1976
(Contract E(45-1)-1830)
(BNWL-SA-5798; Conf-760906-4) Avail: NTIS HC A02/MF A01

This analysis uses a computer simulation of the U.S. electrical economy using a linear programming optimization technique. Under most of the scenarios, the benefits are estimated at $2-$4 billion over the next 50 years on a discounted present value basis. The electricity production from hydrothermal plants reaches 2-4 percent of the national total which will represent 10-20 percent of the installed capacity in the West. Installed geothermal capacity in 1990 is estimated to reach 9,000-17,000 NWe. ERA

**N77-19584#** Chicago Univ., Ill. Enrico Fermi Inst.
**SOLAR ENERGY CONCENTRATION Progress Report, 1 Jul. 1975 - 31 Mar. 1976**
R. Winston Mar. 1976 13 p
(Contract E(11-1)-2446)
(COO-2446-7) Avail: NTIS HC A02/MF A01

The optical and thermal properties of ideal concentrators which concentrate radiation by the maximum amount possible for a given range of angular acceptance have been under investigation. This has been done experimentally, analytically and numerically. The following reflector-absorber combinations have been studied: (1) flat receiver, parabolic reflector (compound parabolic concentrator, or CPC), (2) vertical fin receiver inside half-aluminized evacuated glass tube coupled to CPC, (3) vertical fin receiver, circular-parabolic reflector, (4) circular cylindrical receiver, extended involute reflector, (5) convex receiver, lens at entrance aperture, hyperbolic reflectors, (6) arbitrary receiver shape, CPC modified to limit angle of incidence onto receiver, (7) concentrators with a gap between the receiver and the reflector for thermal isolation, (8) concentrators used as a second stage concentrator, formed from a solid dielectric material. ERA

**N77-19585#** Hittman Associates, Inc., Columbia, Md.
**COEFFICIENT OF PERFORMANCE FOR SOLAR-POWERED SPACE COOLING SYSTEMS**
H. M. Curran 1976 9 p Presented at Am. Soc. Heating Refrig. and Air-Conditioning Eng. Ann. Meeting, Seattle, 27 Jun. - 1 Jul. 1976 Sponsored by ERDA
(CONF-760618-1) Avail: NTIS HC A02/MF A01

A generalized outline of the energy inputs to solar-powered cooling machines is presented in order to establish a common basis for computations of coefficient of performance. Although a number of the energy inputs are not commonly included for conventional systems, their inclusion for solar system performance computations is recommended because of the wide range of the ratio of nonsolar to solar energy inputs for the different solar-powered cooling machines. In order to accommodate the variety of solar-powered cooling concepts, the use of a set of conditions which are related to the cooling load is recommended as the basis for comparative computations. ERA

**N77-19586#** California Univ., Livermore. Lawrence Livermore Lab.
**HELICAL-ROTOR EXPANDER APPLICATIONS FOR GEOTHERMAL ENERGY CONVERSION**
P. A. House 1 Apr. 1976 26 p refs
(Contract W-7405-eng-48)
(UCRL-52043) Avail: NTIS HC A03/MF A01

The potential exists for expansion efficiencies as high as 70 percent. Engine efficiencies will generally be below 70 percent because of an expansion-ratio limitation of 15 and a maximum pressure differential of 110 psi. Single-stage expansion of self-pumped geothermal fluids from reservoirs at 350 to 752 F gives engine efficiencies in the range from 57.3 to 43.1 percent. Calculated rotor diameters range from 10.5 to 41.6 ft for a range of outputs of 5 to 40 MW. Two-stage expansion of fluid from the 572 F reservoir gives an engine efficieny of 62.3 percent and a 21 percent reduction in the diameter of the larger rotor. Rotor diameters can be held to more reasonable sizes by using the expander in combination with a vapor turbine. ERA

**N77-19587#** California Univ., Livermore. Lawrence Livermore Lab.
**INVESTIGATION OF HEAT EXCHANGER FLOW ARRANGEMENT ON PERFORMANCE AND COST IN A GEOTHERMAL BINARY CYCLE**
Warren H. Giedt 15 Jun. 1976 8 p refs Presented at 11th Intersociety Energy Conversion Eng. Conf., State Line, Nev., 12 Sep. 1976
(Contract W-7405-eng-48)
(UCRL-78390; Conf-760906-11) Avail: NTIS HC A02/MF A01

The performance of an idealized geothermal binary-fluid-cycle energy conversion system is shown to be a function of the temperature of brine and working fluid leaving the heat exchanger. System power output, heat exchanger area required and initial well and heat exchanger costs are determined for counterflow, single and multi-pass parallel-counterflow exchangers. Results are presented graphically as functions of the brine and working fluid exit temperatures from the exchanger. Use of the system analysis developed is illustrated by showing quantitatively the advantage of the counterflow over the other flow arrangements considered. ERA

**N77-19588#** California Univ., Livermore. Lawrence Livermore Lab.

**STATUS REPORT: LAWRENCE LIVERMORE LABORATORY WIND ENERGY STUDIES**

Joseph B. Knox, D. M. Hardy, and T. J. Sullivan Jun. 1976 20 p ref

(Contract W-7405-eng-48)

(UCID-17157-1) Avail: NTIS HC A02/MF A01

Numerical model calculations of three-dimensional regional wind fields oriented toward identifying the location, intensity and extent of wind energy-rich areas on Oahu are reported. The use of these calculations in planning a field data-collection program to study areas of expected high wind energy is described. Criteria for the selection of wind energy subregions of primary interest are discussed. ERA

**N77-19589#** California Univ., Berkeley. Lawrence Berkeley Lab.

**GEOTHERMAL STUDIES IN NORTHERN NEVADA**

Harold A. Wollenberg Jun. 1976 8 p refs Presented at 11th Intersoc. Energy Conversion Eng. Conf., Lake Tahoe, Calif., 9 Sep. 1976

(Contract W-7405-eng-48)

(LBL-4451; Conf-760904-3) Avail: NTIS HC A02/MF A01

Field studies presently being conducted in northern Nevada incorporate an integrated program of geologic, geophysical, and geochemical surveys leading to heat flow measurements, and eventually to deep (1.5 to 2 km) confirmatory drill holes. Techniques evaluated include geophysical methods to measure contrasts in electrical resistivity and seismic parameters. Geochemical studies have emphasized techniques to disclose the pathways of water from its meteoric origin into and through the hydrothermal systems. Geochemical and radiometric analyses also help to provide a baseline upon which the effects of future geothermal development may be superimposed. ERA

**N77-19590#** Brookhaven National Lab., Upton, N.Y.

**DATA NEEDS FOR ENERGY POLICY ASSESSMENT**

Murrey D. Goldberg Jun. 1976 13 p refs Presented at 5th Biennial Intern. CODATA Conf., Boulder, Colo., 28 Jun. - 1 Jul. 1976

(Contract E(30-1)-16)

(BNL-21572; Conf-760643-4) Avail: NTIS HC A02/MF A01

The results of this study should provide a framework within which detailed work can proceed. Another area of data collection pertinent to energy conservation consideration is that of materials. The extraction, processing, fabrication, distribution, and usage of materials require a substantial fraction of the energy used each year in most industrialized countries. Improvements in the efficient use of energy in the various processes involved in materials production offer a source of considerable energy savings, as does the substitution of less energy-intensive materials for more energy intensive ones. A framework has been proposed within which materials-related options and tradeoffs can be considered. ERA

**N77-19591#** Battelle Pacific Northwest Labs., Richland, Wash.

**POTENTIAL BENEFITS OF GEOTHERMAL ELECTRICAL PRODUCTION FROM HYDROTHERMAL RESOURCES**

C. H. Bloomster and R. L. Engel Jun. 1976 85 p refs

(Contract E(45-1)-1830)

(BNWL-2001) Avail: NTIS HC A05/MF A01

The potential national benefits of geothermal electric energy development from the hydrothermal resources in the West are estimated for several different scenarios. The U.S. electrical economy is simulated by computer using a linear programming optimization technique. Under most of the scenarios, benefits are estimated at $2 to $4 billion over the next 50 years on discounted present value basis. The electricity production from hydrothermal plants reaches 2 to 4 percent of the national total, which will represent 10 to 20 percent of the installed capacity in the West. Installed geothermal capacity in 1990 is estimated to be 9,000 to 17,000 Mw(e). Supply curves were developed for hydrothermal resources based on the recent U.S. Geological Survey (USGS) resource assessment, resource characteristics, and projected power conversion technology and costs. ERA

**N77-19592#** Battelle Pacific Northwest Labs., Richland, Wash.

**CAPITAL COST MODELS FOR GEOTHERMAL POWER PLANTS**

Paul D. Cohn and C. H. Bloomster Jul. 1976 64 p refs

(Contract E(45-1)-1830)

(BNWL-1990) Avail: NTIS HC A04/MF A01

A computer code was developed to rapidly systematically calculate the potential costs of geothermal power. A description of the cost models for the geothermal power plants is given here. Plant cost models include the flashed steam and binary systems. The data sources are described, along with the cost data correlations, resulting equations, and uncertainties. Comparison among plant cost estimates are presented. The models are intended to predict plant costs for second and third generation units, rather than the more expensive first-of-a-kind units. ERA

**N77-19593#** Argonne National Lab., Ill.

**HIGH-PERFORMANCE BATTERIES FOR OFF-PEAK ENERGY STORAGE AND ELECTRIC-VEHICLE PROPULSION Progress Report, Jan. - Mar. 1976**

P. A. Nelson, R. O. Ivins, N. P. Yao, J. E. Battles, A. A. Chilenskas, E. C. Gay, R. K. Steunenberg, and W. J. Walsh May 1976 56 p refs

(Contract W-31-109-eng-38)

(ANL-76-35) Avail: NTIS HC A04/MF A01

The research and management efforts on lithium/metal sulfide batteries are described. These batteries are being developed for energy storage on utility networks and for electric-vehicle propulsion. The present cells are vertically oriented, prismatic cells with a central positive electrode of FeS or FeS2 and two facing negative electrodes of lithium-aluminum alloy, and an electrolyte of molten LiCl-KCl. The cell operating temperature is 400 to 450 C. The type of cell receiving major attention is one in which the electrodes are assembled in the uncharged state. The active material in the positive electrode is a mixture of Li2S and iron; the electrode is formed by hot-pressing this material with electrolyte, by loading it into a porous structure of metal, or by incorporating it into a carbon-bonded structure.ERA

**N77-19594#** Oak Ridge National Lab., Tenn.

**NUCLEAR DUAL-PURPOSE FOR INDUSTRIAL ENERGY**

O. H. Klepper 1976 29 p refs Presented at 11th Intersoc. Energy Conversion Eng. Conf., State Line, Nev., 12 Sep. 1976

(Contract W-7405-eng-26)

(CONF-760906-3) Avail: NTIS HC A03/MF A01

One of the major obstacles to extensive application of nuclear power to industrial heat is the difference between the relatively small energy requirements of individual industrial plants and the large thermal capacity of current power reactors. A practical way of overcoming this obstacle would be to operate a centrally located dual-purpose power plant that would furnish process steam to a cluster of industrial plants, in addition to generating electrical power. The present study indicates that even relatively remote industrial plants could be served by the power plants, since it might be possible to convey steam economically as much as ten miles or more. A survey of five major industries indicates a major potential market for industrial steam from large nuclear power stations. ERA

**N77-19595#** Oak Ridge National Lab., Tenn.

**ENERGY CONSERVATION POTENTIAL OF MODULAR INTEGRATED UTILITY SYSTEMS (MIUS)**

W. R. Mixon and C. L. Segaser 1976 14 p refs Presented at 11th Intersoc. Energy Conversion Conf., State Line, Nev., 12-17 Sep. 1976 Sponsored in part by HUD

(Contract W-7405-eng-26)

(CONF-760906-13) Avail: NTIS HC A02/MF A01

The Department of Housing and Urban Development is conducting the Modular Integrated Utility System (MIUS) Program devoted to development and demonstration of the technical, economic, and institutional advantages of integrating the systems for providing all or several of the utility services for a community. Possible utility services include electric power, space heating and cooling, potable water, and liquid and solid waste treatment. The concept utilizes a relatively small, combined utility plant located on the development site and has the objective of providing utility services in a way that reduces the use of critical natural resources protects the environment, and minimizes cost. ERA

**N77-19596#** Los Alamos Scientific Lab., N.Mex.
**SUPERCONDUCTING MAGNETIC ENERGY STORAGE PROJECT AT LASL Progress Report, 1 Oct. 1975 - 31 Mar. 1976**
W. V. Hassenzahl Jul. 1976 20 p refs
(Contract W-7405-eng-36)
(LA-6434-PR) Avail: NTIS HC A02/MF A01

Details are reported on the design of a superconducting magnet energy storage system. Special circuits were designed to deposit the stored energy outside of the dewar when a quench is detected. A 6-pulse (3-phase) ac-dc-ac converter was successfully tested on a small 70-H coil, and additional components have been acquired to modify the converter for 12-pulse operation. ERA

**N77-19597#** Los Alamos Scientific Lab., N.Mex.
**PRELIMINARY ASSESSMENT OF A GEOTHERMAL ENERGY RESERVOIR FORMED BY HYDRAULIC FRACTURING**
Hugh D. Murphy, Robert G. Lawton, Jefferson W. Tester, Robert M. Potter, Donald W. Brown, and R. Lee Aamodt 1976 18 p refs Presented at 51st Ann. Meeting of the Soc. of Petrol. Eng., New Orleans, 3-6 Oct. 1976
(Contract W-7405-eng-36)
(LA-UR-76-1672; Conf-761008-1) Avail: NTIS HC A02/MF A01

Two, 3-km-deep boreholes have been drilled into hot (approximately 200 C) graphite in northern New Mexico in order to extract geothermal energy from hot dry rock. Both boreholes were hydraulically fractured to establish a flow connection. Presently this connection has a large flow impedance which may be improved with further stimulation. Fracture-to-borehole intersection locations and in situ thermal conductivity were determined from flowing temperature logs. In situ measurements of permeability show an extremely strong dependence upon pore pressure--the permeability increased by a factor of 80 as the pressure was increased 83 bars (1200 psi). An estimate of the minimum horizontal earth stress was derived from fracture extension pressures and found to be one-half the overburden stress. ERA

**N77-19598#** Los Alamos Scientific Lab., N.Mex.
**EXTRACTING ENERGY FROM HYDRAULICALLY-FRACTURED GEOTHERMAL RESERVOIRS**
R. D. McFarland and H. D. Murphy 1976 12 p refs Presented at 11th Intersoc. Energy Conversion Eng. Conf., State Line, Nev., 12-17 Sep. 1976
(Contract W-7405-eng-36)
(LA-UR-76-848; Conf-760906-10) Avail: NTIS HC A02/MF A01

The governing equations for heat and mass transfer were derived for hydraulically fractured geothermal reservoirs. When converted to nondimensional form it was shown that the equations can be considerably simplified. The resulting equations can be strongly influenced by the effects of buoyancy; the magnitude of the effect is measured by the ratio of the Grashof and Reynolds numbers, and the ratio of the actual permeability of the fracture and the square of the fracture gap width. Significant quantities of energy can be extracted from hydraulic fractures--even without thermal stress fracturing. The amount is limited by the size of the fracture and the low thermal conductivity of rock. The viscous pressure drop in open fractures is insignificant, and depending upon losses in piping and surface equipment, the entire system could be 'self-pumped' due to buoyancy. Thermal contraction of the rock tends to increase the fracture gap width - thus decreasing viscous pressure drops and increasing the effects of buoyancy. ERA

**N77-19599#** Denver Research Inst., Colo.
**TWO-PHASE FLOW IN GEOTHERMAL ENERGY SOURCES Annual Report, 1 Jun. 1975 - 31 May 1976**
Laurence W. Ross 1976 27 p
(Contract E(11-1)-2729)
(COO-2729-2) Avail: NTIS HC A03/MF A01

A Design Manual is created for the design of geothermal production wells that operate in the two-phase flow regime. ERA

**N77-19600#** Energy Research and Development Administration, Washington, D.C.
**NATIONAL PLAN FOR ENERGY RESEARCH, DEVELOPMENT AND DEMONSTRATION: CREATING ENERGY CHOICES FOR THE FUTURE. VOLUME 2: PROGRAM IMPLEMENTATION**
1976 409 p
(ERDA-76-1-Vol-2) Avail: NTIS HC A18/MF A01

The Federal energy research, development, and demonstration programs now underway are described along with possible future efforts. Financial data for FY 75, FY 76, and FY 77 are presented. Energy technology programs, supporting technology programs, energy-related supporting activities, special analyses, and an appendix are included. Fossil energy (coal, petroleum, and natural gas), solar energy, and geothermal energy, are discussed together with conservation, fusion power, fission power, and the nuclear fuel cycle. ERA

**N77-19601#** Energy Research and Development Administration, Washington, D.C.
**SYSTEMS ENGINEERING FOR POWER**
May 1976 95 p refs
(ERDA-76-82/1) Avail: NTIS HC A05/MF A01

Existing program and long term objectives, through the request for proposals (RFP's) are presented defining the problem areas and through short description of the various projects which are funded. The format is modular to facilitate additions which will be provided as new program areas and projects are funded. Each program area is treated as an entity with the background statement and objective of the RFP serving as a description of the problem area and outline of objectives. ERA

**N77-19602#** Bechtel Corp., San Francisco, Calif.
**REGIONAL ENERGY SYSTEM FOR THE PLANNING AND OPTIMIZATION OF NATIONAL SCENARIOS (RESPONS). CLEAN COAL ENERGY: SOURCE-TO-USE ECONOMICS PROJECT Final Report**
Phiroze J. Nagarvala, G. C. Ferrell, and L. A. Olver Jun. 1976 633 p refs
(Contract E(49-18)-1552)
(ERDA-76-109; FE-1552-18) Avail: NTIS HC A99/MF A01

The result of this effort is a regional linear programming model of an integrated U.S. energy delivery system that will assist the energy planner in analyzing the response of the energy system to a large number of variables. The model may be used for analyzing actual and proposed energy delivery systems in terms of a number of variables, including quality of coal at the mine, energy transportation or transmission modes, the amount and form of the delivered energy, the distance between source and user or processor, coal-energy conversion and cleanup processing methods, and existing and proposed environmental regulations. ERA

**N77-19603#** Dow Chemical Co., Midland, Mich.
**POTENTIAL INDUSTRIAL MARKET FOR PROCESS HEAT FROM NUCLEAR REACTORS**
R. W. Barnes Jul. 1976 201 p refs Prepared in cooperation with ORNL
(Contract W-7405-eng-26)
(ORNL-TM-5516) Avail: NTIS HC A10/MF A01

A specific segment of industrial process heat use has been examined in detail to identify individual plant locations throughout the United States where nuclear generated steam may be a viable alternative. Five major industries have been studied: paper, chemicals, petroleum, rubber, and primary metals. For these industries, representing 75 percent of the total industrial steam consumption, the individual plant locations within the U.S. using steam in large quantities have been located and characterized as to fuel requirements. ERA

**N77-19604#** Electric Power Research Inst., Palo Alto, Calif.
**ENERGY STORAGE: USER NEEDS AND TECHNOLOGY APPLICATIONS**
1976 60 p Presented at the Eng. Found. Conf., Pacific Grove, Calif., 8-13 Feb. 1976 Prepared in cooperation with ERDA
(CONF-760212-Summ) Avail: NTIS HC A04/MF A01

Brief summaries of nine papers and topics of seven working groups are presented. ERA

**N77-19605#** General Electric Co., Philadelphia, Pa. Space Div.
**TECHNICAL AND ECONOMIC FEASIBILITY OF THERMAL ENERGY STORAGE Annual Report**
D. R. Glenn Feb. 1976 569 p refs
(Contract E(11-1)-2558)
(COO-2558-1) Avail: NTIS HC A24/MF A01

Implicated markets, Energy consumption patterns, TES (Thermal Energy Storage) technologies, and applications are reviewed. Further, several concepts are developed and evaluated in some detail. Key findings are: (1) there are numerous technical opportunities for TES in the residential and industrial market sectors, (2) apart from sensible heat storage and transfer, significant R and D is required to fully exploit the superior heat densities of latent heat-based TES systems, particularly at temperatures above 600 F (3) industrial energy conservation can be favorably impacted by TES where periodic or batch-operated unit functions characterize product manufacturing processes, i.e. bricks, steel, and ceramics; and (4) a severe data shortage exists for describing energy consumption rates in real time as related to plant procees operations - a needed element in designing TES systems. ERA

**N77-19606#** General Electric Co., Philadelphia, Pa. Space Div.
**GENERAL ELECTRIC COMPANY PROPOSED TEST AND EVALUATION PLAN, COMMERCIAL BUILDINGS National Solar Demonstration Program**
Apr. 1976 240 p
(Contract E(11-1)-2683)
(COO-2683-76-4) Avail: NTIS HC A11/MF A01

The general requirements and methods for instrumenting, testing, and evaluating solar HVAC systems are defined. Design requirements are specified for the performance of components and subsystems comprising the instrumentation and data gathering system, as well as the support functions required to perform the diagnostic measurements, collection and processing of data, and documentation of reports on solar HVAC system performance, including economic and societal evaluations. ERA

**N77-19607#** Idaho National Engineering Lab., Idaho Falls.
**GEOTHERMAL R AND D PROJECT REPORT, 1 JANUARY - 31 MARCH 1976**
Jun. 1976 69 p refs
(Contract E(10-1)-1375)
(ANCR-1319) Avail: NTIS HC A04/MF A01

The Raft River well developments, reservoir testing, and surface testing; the Boise Space Heating Project; the design and analysis of power conversion concepts for generating electricity from moderate temperature (approximately 150 C or 300 F) resources; advanced heat exchanger research and testing; and studies relating to a variety of direct uses of geothermal heat energy are reported. ERA

**N77-19608#** Notre Dame Univ., Ind.
**WORKSHOP ON ELECTRIC POWER GENERATION: COMPARATIVE RISKS AND BENEFITS**
1975 29 p refs Presented at the Workshop on Elec. Power Generation, Notre Dame, Ind., 7 Jul. 1975 Sponsored by ERDA
(CONF-750763-1) Avail: NTIS HC A03/MF A01

A 5-day workshop on the risks and benefits of power generation was held for high school science teachers. Attendees were required to submit papers discussing how they would use the workshop materials in their courses. Two such papers are included. ERA

**N77-19609#** Southwest Research Inst., San Antonio, Tex.
**OPERATIONAL, COST, AND TECHNICAL STUDY OF LARGE WINDPOWER SYSTEMS INTEGRATED WITH EXISTING ELECTRIC UTILITY**
R. T. Smith, R. K. Swanson, C. C. Johnson, C. Ligon (Southwestern Public Service Co., Amarillo, Tex.), J. Lawrence (Tex. Tech. Univ., Lubbock, Tex.), and D. Jordan (Tex. Tech. Univ., Lubbock, Tex.) 1976 7 p Presented at the 11th Intersociety Energy Conversion Eng. Conf., State Line, Nev., 12 Sep. 1976
(Contract E(11-1)-2621)
(CONF-760906-8) Avail: NTIS HC A02/MF A01

A comprehensive study of the operational, cost, and technical aspects of large windpower systems integrated with existing electric utility networks has been carried out for a region of the Texas Panhandle. ERA

**N77-19610#** Mitre Corp., McLean, Va.
**METHODOLOGY FOR RANKING GEOTHERMAL RESERVOIRS IN NON-ELECTRIC INDUSTRIAL APPLICATIONS**
O. G. Farah and F. Williams May 1976 95 p refs
(Contract E(11-1)-2693)
(MTR-7241; COO-2693-76-2) Avail: NTIS HC A05/MF A01

A large number of geothermal reservoirs exist and to perform a thorough study of each of these reservoirs to determine those most desirable for demonstration projects can be costly and time consuming. A methodology for assigning rankings to these reservoirs, given a limited amount of data, is presented. The top ranked reservoirs would then be studied more thoroughly. In addition, a methodology for ranking the large number of industries that could possibly utilize geothermal energy in nonelectric applications is given to determine those industries which will have the most impact on national energy demand if converted to geothermal use. ERA

**N77-19611#** Energy Research and Development Administration, Washington, D.C.
**FOSSIL ENERGY RESEARCH PROGRAM OF THE ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION, FY 1977**
Apr. 1976 276 p refs
(ERDA-76-63) Avail: NTIS HC A13/MF A01

The research planned and documented is guided by the following overall programs goals: to develop the technology needed to make fossil fuels available in the form and quantity needed, and to assure that the nation's fossil fuels resources are developed at acceptable economic, social, and environmental costs. Funding requirements for the programs discussed are based on the attainment of these major goals. Author

**N77-19612#** Rogers Engineering Co., Inc., San Francisco, Calif.
**MODULAR 5 MW GEOTHERMAL POWER PLANT DESIGN CONSIDERATIONS AND GUIDELINES**
May 1976 139 p ref Prepared for Lawrence Livermore Lab. Supported in part by NATO Committee on the Challenges of Modern Society
(Contract W-7405-eng-48)
(UCRL-13684) Avail: NTIS HC A07/MF A01

The design considerations and guideline documents define the prinicipal design requirements for a nominal 5 MW geothermal power plant of a type to permit over-the-road transport of its several modules. The power plant system defined is supplied with steam from a single flash steam separator stage, located at the plant area, and supplied with steam from two wells at nominal pressure of 3.8 Kg per square cm. Guidelines are given for the following: site preparation, collection system, plant installation, assembly, and test; turbine generator module; condenser and noncondensable gas removal module; plant control and switchgear module; cooling water circulation pump module; steam-water separator module; maintenance, office, and lavatory module; reinjection pump module; cooling tower modules; spray pond installation and piping; and auxiliary generator module. GRA

**N77-19613#** Hamilton Standard, Windsor Locks, Conn.
**EXPERIMENTAL AND ANALYTICAL RESEARCH ON THE AERODYNAMICS OF WIND TURBINES Mid-Term Technical Report, 1 Jun. - 31 Dec. 1975**
C. Rohrbach Feb. 1976 111 p refs
(Contract E(11-1)-2615)
(COO-2615-76-T-1) Avail: NTIS HC A06/MF A01

Information is presented concerning aerodynamic design and performance technology, wind turbine parametric performance study, selection of model wind turbine configurations, and structural design of wind turbine models. ERA

**N77-19614#** Idaho National Engineering Lab., Idaho Falls.
**PLAN FOR DEVELOPING MODERATE TEMPERATURE/LOW SALINITY GEOTHERMAL RESOURCES**
Jay F. Kunze and Judson F. Whitbeck May 1976 91 p refs

(Contract E(10-1)-1375)
(ANCR-1318) Avail: NTIS HC A05/MF A01

The approach to developing moderate temperature (150 to 300 F) geothermal resources so that these can competitively enter the energy market is herein described. The specifics discussed relate to experiments in the Idaho National Engineering Laboratory's program effort. These involve the energy supply and disposal systems, the surface conversion equipment for generating electricity, and supplementary uses of the heat directly for industrial and agricultural applications. The experimental facilities are located in the Raft River Valley area of southcentral Idaho, close to the Utah border, and the document describes the purpose and likely economic benefit to result from this experimental program. ERA

**N77-19615#** InterTechnology Corp., Warrenton, Va.
**TECHNOLOGY EVALUATION REPORT, COMMERCIAL BUILDINGS**
Apr. 1976 159 p refs
(Contract E(11-1)-2683)
(COO-2688-76-1) Avail: NTIS HC A08/MF A01

Criteria are presented which are to be met by solar hardware for inclusion in the demonstration program. Assessments are made, based on a survey made of solar hardware manufacturers and developers, of when components, subsystems, and systems will be available for demonstration according to the technology status categories. Task outlines are provided for development activity recommended to improve available systems or develop advanced systems for later demonstration cycles. ERA

**N77-19616#** Sandia Labs., Albuquerque, N.Mex.
**DARRIEUS VERTICAL-AXIS WIND TURBINE PROGRAM AT SANDIA LABORATORIES**
Emil G. Kadlec 1976 11 p refs Presented at Sharing the Sun, Solar Technology in the Seventies Conf., Winnipeg, Canada, 15 Aug. 1976
(Contract AT(29-1)-789)
(SAND-76-5712; Conf-760821-7) Avail: NTIS HC A02/MF A01

The Darrieus Vertical Axis Wind Turbine (VAWT) technology development program is described. The application receiving emphasis utilizes the VAWT operating at constant speed to generate electricity which is fed directly into a utility grid. ERA

**N77-19617#** Battelle Pacific Northwest Labs., Richland, Wash.
**STRUCTURE OF A SIMULATION MODEL FOR ENERGY-RELATED REGIONAL ASSESSMENT**
D. W. Fraley and W. H. Swift 1976 23 p refs Presented at 7th Ann. Conf. on Modeling and Simulation, Pittsburgh, 26 Apr. 1976
(Contract E(45-1)-1830)
(BNWL-SA-5677; Conf-760435-4) Avail: NTIS HC A02/MF A01

The structure of a dynamic simulation model designed to analyze the effects of potential future energy policies and actions as a multistate, regional level is described. The simulation structure includes the interacting effects of energy development, energy- and macro-economics, and demography on land use, water resources, air quality, ecosystems, and society. ERA

**N77-19618#** Brookhaven National Lab., Upton, N.Y.
**SOURCEBOOK FOR ENERGY ASSESSMENT**
M. Beller, ed. Dec. 1975 211 p refs
(Contract E(30-1)-16)
(BNL-50483) Avail: NTIS HC A10/MF A01

An analytical approach is presented that is broadly applicable to the assessment of energy technologies and policies. Using the Reference Energy System approach, it permits the examination of the economic, environmental, and resource implications resulting from the substitution of one fuel or technology for another. Included as tools for such analyses are the necessary data and methodology, as well as a set of Reference Energy Systems covering the 1972-2020 period to serve as baselines for the perturbation analyses of interest. ERA

**N77-19619#** Sandia Labs., Albuquerque, N.Mex.
**PERSPECTIVE ON MATERIALS IN THE ENERGY PROGRAM**
R. S. Claassen 22 Jan. 1976 34 p refs Presented at Distinguished Lecture Series 2, Albuquerque, N. Mex. 22 Jan. 1976 Sponsored by ERDA
(SAND-76-5155) Avail: NTIS HC A03/MF A01

The uses of energy and the forms that energy must take to be consumable are summarized. Financial aspects, particularly capitalization problems and fuel expenses, are covered. A brief description of the materials problems are discussed. ERA

**N77-19620#** Brookhaven National Lab., Upton, N.Y.
**RELATIONSHIP OF ENERGY GROWTH TO ECONOMIC GROWTH UNDER ALTERNATIVE ENERGY POLICIES**
D. J. Behling, Jr., R. Dullien, and E. Hudson Mar. 1976 247 p refs
(Contract E(30-1)-16)
(BNL-50500) Avail: NTIS HC A11/MF A01

The economic and social impacts of research, development, and demonstration plans of the Energy Research and Development Adminstration were analyzed. Two policy proposals were examined against a base case set of economic and energy projections for the years 1985, 1990, and 2000: (1) the introduction of RD and D-initiated energy supply and end-use conversion technologies to expand domestic energy supply and to improve the efficiency and flexibility of its use; and (2) the imposition of taxes and tariffs on petroleum and natural gas to reduce demand for these primary energy sources. Targets for the amounts of imports of oil and gas were specified. The degree to which the introduction of new energy technologies and/or the imposition of energy taxes could reduce oil and gas imports toward the target levels was identified; and the effects of these policies on the economy and the environment were estimated. These economic and environmental effects are thus a measure of the analytic framework which linked detailed mathematical process engineering and economic models to more aggregate econometric models. The four models employed are described. ERA

**N77-19621#** Argonne National Lab., Ill.
**HIGH-PERFORMANCE BATTERIES FOR OFF-PEAK ENERGY STORAGE AND ELECTRIC-VEHICLE PROPULSION Progress Report, Jul. - Dec. 1975**
Apr. 1976 97 p refs
(Contract W-31-109-eng-38)
(ANL-76-9) Avail: NTIS HC A05/MF A01

The battery designs for the two applications differ, particularly in cell configuration and electrode design, because of the differing performance requirements. The present cells are vertically oriented, prismatic cells with two negative electrodes of a solid lithium-aluminum alloy and a central positive electrode of iron sulfide (FeS2 or FeS). The electrolyte is molten LiCl-KCl eutectic, which requires a cell temperature of about 400-450 C. Effort was continued on the development of engineering-scale cells with hot-pressed electrodes assembled in the uncharged state (positive electrode of Li2S-Fe, negative electrode of Al). Studies of electrodes were directed principally toward developing positive electrodes of FeS2 and FeS in carbon-bonded structures and toward improving the performance and lowering the cost of negative Li-Al electrodes. ERA

**N77-19622#** California Univ., Livermore. Lawrence Livermore Lab.
**BATTERY-FLYWHEEL HYBRID ELECTRIC POWER SYSTEM FOR NEAR-TERM APPLICATION. VOLUME 1: SYSTEM DESCRIPTION**
D. D. Davis, L. G. OConnell, S. E. Warner, A. E. Raynard, and B. H. Rowlett 15 Apr. 1976 52 p refs 3 Vol.
(Contract W-7405-eng-48)
(UCID-17098-Vol-1) Avail: NTIS HC A04/MF A01

A description is given of a hybrid propulsion system design, based upon demonstrated technology, that substantially improves performance, range, and consumer acceptability of a battery-powered electric vehicle. A newly demonstrated high energy composite flywheel is coupled to an extremely simple, efficient, electro-mechanical transmission. Lead acid batteries provide the prime power source. Interactive control of battery and flywheel drive power is provided by a versatile microprocessor-based power control unit. Efficient recovery of vehicle kinetic energy during braking, plus the energy base required to meet all high power transient demands, is provided by the flywheel. Battery demand is stabilized at a low average value resulting in improved battery

performance through increases in both cycle life and available energy. Electric vehicle acceleration and range improvements due to the hybrid system described are predicted to be in excess of 80 percent for a vehicle operated in a stop-and-go commuter environment. ERA

**N77-19623#** Argonne National Lab., Ill.
**BASELINE ENERGY CONSUMPTION FORECASTS FOR TRANSPORTATION: A REVIEW AND EVALUATION**
F. Koppelman, P. OSullivan, and T. Collum May 1976 42 p refs
(Contract W-31-109-eng-38)
(ANL-76-XX-6) Avail: NTIS HC A03/MF A01

A baseline projection of energy consumption is needed to estimate the potential energy savings from proposed transport technology and operational improvements. Attention is focused on the growth rate assumptions of the forecasts and the allowances made for the sensitivity of transport demand and technological efficiency to fuel price changes. The alternative trajectories of energy use are examined for automobile, bus and intercity air and rail passenger travel, and also for freight movement. ERA

**N77-19624#** Oak Ridge National Lab., Tenn.
**DEVELOPMENT OF THE ICE-MAKER HEAT PUMP**
H. C. Fischer 1976 13 p Presented at the Ann. Meeting of the ASHRAE, Seattle, 27 Jun. - 1 Jul. 1976 Supported in part by HUD
(Contract W-7405-eng-26)
(CONF-760618-2) Avail: NTIS HC A02/MF A01

The development of the ice-maker heat pump provides another tool to reduce the amount of energy it takes to heat and cool buildings. By using both the heating and cooling outputs of the heat pump, great energy savings can be made. The ice (cooling output) can be stored to meet air conditioning loads that occur during utility peak, thus, reducing peak demands as well as saving energy. Design features of the ice-maker heat pump are discussed. ERA

**N77-19625#** Oak Ridge National Lab., Tenn.
**RESIDENTIAL ENERGY USE ALTERNATIVES TO THE YEAR 2000**
E. Hirst 1976 16 p refs Presented at National Science Foundation Workshop on Long-run Energy Demands, McLean, Va., 9 Jun. 1976 Sponsored by ERDA
(CONF-760648-1) Avail: NTIS HC A02/MF A01

A comprehensive engineering-economic computer model used to simulate energy use in the residential sector from 1970 to 2000. The purpose of the model is to provide an analytical tool with which to evaluate a variety of conservation policies, technologies, and strategies for their impacts on residential energy use and fuel expenditures over time. The baseline forecast developed shows total fuel use growing from 17.6 GGJ in 1975 to 26.4 GGJ in 2000, with an average annual growth rate of 1.7 percent. The percentage of household fuel provided by electricity grows from 44 percent in 1975 to 56 percent in 2000. ERA

**N77-19626#** California Univ., Livermore. Lawrence Livermore Lab.
**CHANGING ENERGY PERSPECTIVES**
1976 13 p refs Presented at the Am. Inst. of Aeron. and Astronautics Symp. on Alternate Fuel Resources, Santa Maria, Calif., 25 Mar. 1976
(Contract W-7405-eng-48)
(UCRL-78153) Avail: NTIS HC A02/MF A01

Several new developments call for a reassessment of the U.S. energy independence strategy: (1) conservation programs have not been effectively implemented; (2) industry is not building synthetic fuel production plants; and (3) a projected world wide expansion of oil production may actually lead to price reductions in the 1980's followed by price increases in the 1990's. The Stanford Research Institute energy market model is used to evaluate these new developments. It indicates that acceleration of research and development on synthetic fuels and on increasing the efficiency of energy use may lead to reductions of over $100 billion in the total annual U.S. energy bill in the year 2000 and to a reduction of $30 billion in the total annual energy import bill. Since transportation is the most inefficient sector in terms of energy use, and more and more Americans seem to prefer suburban living, increasing the efficiency of the automobile is crucial. ERA

**N77-19627#** California Univ., Livermore. Lawrence Livermore Lab.
**ENERGY AND TECHNOLOGY REVIEW. GEOTHERMAL BRINE STUDIES**
Ronald B. Carr, ed., Richard B. Crawford, ed., Charles S. McCaleb, ed., and Judyth K. Prono, ed. Mar. 1976 26 p refs
(Contract W-7405-eng-48)
(UCRL-52000-76-3) Avail: NTIS HC A03/MF A01

Separate articles are included on geothermal scaling and corrosion, technology transfer, modular microcomputers, and national security. ERA

**N77-19628#** Sandia Labs., Albuquerque, N.Mex.
**OPTICAL MATERIALS FOR SOLAR ENERGY APPLICATIONS**
D. M. Mattox May 1976 43 p refs Presented at the Topical Meeting on Image Processing, Pacific Grove, Calif., 24 Feb. 1976; sponsored by the Optical Soc. of Am., the Am. Vacuum Soc., and the Soc. for Vacuum Coaters Sponsored by ERDA
(SAND-76-5141; Conf-760206-3) Avail: NTIS HC A03/MF A01

It is shown that hundreds of square miles of optical materials, will be required every year for solar energy to have a significant input on the U.S. energy economy. Most of these materials will have to be fabricated at a very low areal cost. Various high volume, low cost production processes applicable to solar optical materials are presented. Major challenges to the optical technologist will be to control the optical properties of materials being fabricated at very high production rates and to develop new cost optical materials. ERA

**N77-19629#** General Electric Co., Philadelphia, Pa. Space Div.
**TECHNOLOGY EVALUATION REPORT FOR COMMERCIAL DEMONSTRATION PROGRAM. EXECUTIVE SUMMARY**
Apr. 1976 22 p refs
(Contract E(11-1)-2683)
(COO/2683-76/6) Avail: NTIS HC A02/MF A01

Status and availability of solar heating and cooling equipment for inclusion in ERDA's Commercial Demonstration Program commensurate with ERDA 23A were assessed. Criteria were developed which are to be met by solar hardware incorporated into the demonstration program. Assessments were made, based on a survey of solar hardware manufacturers and developers, of when components, subsystems, and systems will be available for demonstration according to the technology status categories set forth in ERDA 23A. ERA

**N77-19630#** Sandia Labs., Albuquerque, N.Mex.
**DESIGN CONSIDERATIONS FOR PARABOLIC-CYLINDRICAL SOLAR COLLECTORS**
G. W. Treadwell Jul. 1976 37 p refs 2 Vol.
(Contract AT(29-1)-789)
(SAND-76-0082) Avail: NTIS HC A03/MF A01

The various significant factors which influence the design of parabolic-cylindrical solar collectors are reported in some detail. ERA

**N77-19631#** Sandia Labs., Albuquerque, N.Mex.
**DESIGN CONSIDERATIONS FOR PARABOLIC-CYLINDRICAL SOLAR COLLECTORS**
G. W. Treadwell 1976 18 p 2 Vol.
(Contract AT(29-1)-789)
(SAND-76-5177) Avail: NTIS HC A02/MF A01

The significant factors which influence the design of parabolic-cylindrical solar collectors are presented in some detail. ERA

**N77-19632#** InterTechnology Corp., Warrenton, Va.
**INTERTECHNOLOGY CORPORATION PROPOSED SYSTEMS LEVEL PLAN FOR SOLAR HEATING AND COOLING, COMMERCIAL BUILDINGS. VOLUME 1: NATIONAL SOLAR DEMONSTRATION PROGRAM**
May 1976 221 p 3 Vol.

(Contract E(11-1)-2688)
(COO/2688-76/6-Vol-1) Avail: NTIS HC A10/MF A01

Demonstration site matrix development, site selection methodology, test and evaluation plan, information dissemination plan, program management plan, program coordination and implementation for solar heating and cooling systems of non-residential buildings are presented. ERA

**N77-19633#** InterTechnology Corp., Warrenton, Va.
**INTERTECHNOLOGY CORPORATION PROPOSED SYSTEMS LEVEL PLAN FOR SOLAR HEATING AND COOLING, COMMERCIAL BUILDINGS. VOLUME 2: NATIONAL SOLAR DEMONSTRATION PROGRAM**
May 1976 284 p 3 Vol.
(Contract E(11-1)-2688)
(COO/2688-76/6-Vol-2) Avail: NTIS HC A13/MF A01

Program function, program structure, specifications for input data, description of calculations performed, output format and lists, brief program outline, storage map, and source program outline and listings for solar heating and cooling system of non-residential buildings are presented. ERA

**N77-19634#** InterTechnology Corp., Warrenton, Va.
**INTERTECHNOLOGY CORPORATION PROPOSED SYSTEMS LEVEL PLAN FOR SOLAR HEATING AND COOLING, COMMERCIAL BUILDINGS. VOLUME 3: NATIONAL SOLAR DEMONSTRATION PROGRAM**
May 1976 203 p refs 3 Vol.
(Contract E(11-1)-2688)
(COO/2688-76/6-Vol-3) Avail: NTIS HC A10/MF A01

Development of solar performance data, demonstration site installation schedules, climatic regions and characteristic sites, parametric study alternatives, for solar heating and cooling systems of non-residential buildings are presented. ERA

**N77-19635#** Score, Inc., Cambridge, Mass.
**ENERGY RESOURCES ALTERNATIVES COMPETITION Progress Report, 1 Feb. - 31 Dec. 1975**
D. J. Matzke, D. M. Osowski, and Mark L. Radtke Jan. 1976 208 p refs
(Contract E(11-1)-2698)
(COO-2698-1) Avail: NTIS HC A10/MF A01

The objectives and results of the intercollegiate Energy Resource Alternatives competition are described. The goal of the competition was to design and build prototype hardware which provided space heating and cooling, hot water, and electricity at a level appropriate to the needs of homes, farms, and light industry. The hardware projects were powered by such nonconventional energy sources as solar energy, wind, biologically produced gas, coal, and ocean waves. The competition rules emphasized design innovation, economic feasibility, practicality, and marketability. Author (ERA)

**N77-19636#** Oak Ridge National Lab., Tenn.
**RECOVERY OF INACCESSIBLE COAL RESERVES BY IN SITU GASIFICATION**
R. C. Forrester, III 1976 17 p refs Presented at the 11th Intersoc. Energy Conversion Eng. Conf., State Line, Nev., 12-17 Sep. 1976
(Contract W-7405-eng-26)
(CONF-760906-5) Avail: NTIS HC A02/MF A01

In-situ gasification of coal offers the possibility of providing a much-needed energy option for the United States and of greatly expanding our available resource reserve. Preliminary experiments suggest that costs will be competitive with those for surface processing techniques and that new technology requirements are not unachievable. These factors, coupled with reduced environmental impacts and associated prospects for improved occupational health and safety, are probably sufficient to ultimately assure proven UCG technology a large share of society's overall energy demand. ERA

**N77-19637#** Institute of Gas Technology, Chicago, Ill.
**RESEARCH AND DEVELOPMENT OF RAPID HYDROGENATION FOR COAL CONVERSION TO SYNTHETIC MOTOR FUELS (RISER CRACKING OF COAL)**
Dennis A. Duncan, Justin L. Beeson, and R. Donald Oberle May 1976 39 p
(Contract E(49-18)-2307)
(FE-2307-2) Avail: NTIS HC A03/MF A01

A bench-scale experimental reactor was designed to define the important design parameters in the short residence-time hydrocracking of coal to synthetic motor fuels. The reactor is a 50 foot helical coil of 1/8-in. Incoloy tubing that is heated electrically. Coal feed rates are 5 to 10 lb/hr with residence times of 1 to 10 seconds. The reactor operates up to 2,000 psig at temperatures of 900 to 1500 F. An experimental plan is outlined for Bench-Scale Unit Operations. A detailed operating procedure for the bench-scale unit is included. ERA

**N77-19638#** Sandia Labs., Livermore, Calif. Combustion Research Div.
**COMBUSTION RATES AND MECHANISMS OF PULVERIZED COALS AND COAL-DERIVED FUELS**
D. R. Hardesty Jun. 1976 37 p refs
(Contract AT(29-1)-789)
(SAND-76-8229) Avail: NTIS HC A03/MF A01

The rates and mechanisms of coal devolatilization and combustion are extremely sensitive to local details of the combustion process. Similarly, pollutants formed during the process are sensitive to the initial coal composition and local time and temperature histories of individual particles. Very little useful information is available by which the influence of combustion modifications on both the efficiency and pollutant emission characteristics can be predicted. The present understanding of the rates of coal and char combustion is summarized with the conclusion that heterogeneous chemical kinetic rates strongly influence the rates and mechanisms of coal and char combustion. If understood, adjustment and control of the rates and mechanisms by judicious adjustment of the combustion process and the initial fuel character should be possible. A proposal for a detailed theoretical and experimental study of the combustion rates of pulverized coal and coal-derived fuels is discussed. ERA

**N77-19639#** California Univ., Livermore. Lawrence Livermore Lab.
**HORIZONTAL COLLECTOR WITH A MIRROR ON THE NORTH SIDE**
Arnold F. Clark 21 Jul. 1976 6 p refs Presented at New England Solar Energy Conf., Amherst, Mass., 24 Jun. 1976
(Contract W-7405-eng-48)
(UCRL-77906; Conf-760657-2) Avail: NTIS HC A02/MF A01

A mirror on the north side of a shallow, insulated, and covered pond is an inexpensive way of increasing the heat collection. A sketch and performance figures are given.
Author (ERA)

**N77-19640#** Brookhaven National Lab., Upton, N.Y.
**HYDROGEN STORAGE AND PURIFICATION SYSTEMS III**
J. J. Reilly and R. H. Wiswall 1 Mar. 1976 38 p refs
(Contract E(30-1)-16)
(BNL-21322) Avail: NTIS HC A03/MF A01

Pressure-temperature composition relationships are presented for a number of alloy-hydrogen systems. These include a series of Mg-Al alloys; intermetallic compounds of Mg with Ba and with Ce; several ternary Mg alloys; alloys of Ti with Fe, with Co and with Crp and several ternary Ti alloys. ERA

**N77-19641#** California Univ., Livermore. Lawrence Livermore Lab.
**PRELIMINARY FLOW SHEET AND PROCESS DESIGN FOR ZnSe THERMOCHEMICAL CYCLE**
Henry H. Otsuki and Kenneth E. Cox 21 Jun. 1976 26 p refs
(Contract W-7405-eng-48)
(UCID-17172) Avail: NTIS HC A03/MF A01

A preliminary design of the ZnSe cycle for thermochemical hydrogen production was prepared for use in deriving economic costs for hydrogen production. The process flowsheet identifies key equipment items as well as major streams. Flow and heat loads were estimated based on one mole of hydrogen output. The thermal efficiency of this cycle depends on two factors: (1) the ability to perform the disolution of ZnSO and the hydrolysis of ZnSe with a minimum amount of aqueous HCl, and (2) the the ability to match the process heat requirements with available

heat from the exothermic steps in the cycle. Estimates of the cycle's thermal efficiency range from 34 to 57 percent depending upon the process heat utilization. ERA

**N77-19642#** Virginia Polytechnic Inst. and State Univ., Blacksburg.
**EVALUATION AND TARGETING OF GEOTHERMAL ENERGY RESOURCES IN THE SOUTHEASTERN UNITED STATES Progress Report, 1 May - 30 Jun. 1976**
John K. Costain, L. Glover, III, and A. K. Sinha 1976 33 p refs
(Contract E(40-1)-5103)
(VPI-SU-5103-1) Avail: NTIS HC A03/MF A01

A methodology employing geological, geochemical, and geophysical techniques is developed and applied to determine a radiogenic source buried beneath an insulating blanket of sediments of low thermal conductivity, such as the sedimentary rocks of the Coastal Plain of South Carolina, North Carolina, and Virginia. Preliminary determinations of geothermal gradients in Coastal Plain sediments of South Carolina indicate gradients that range from about 20 C/km to at least 45 C/km. Representative average gradients determined from bottom hole temperatures are about 30 C/km. The observed gradients are consistent with those to be expected for an efficient sedimentary insulator with a low thermal conductivity. ERA

**N77-19643#** Battelle Pacific Northwest Labs., Richland, Wash.
**TECHNICAL AND ECONOMIC FEASIBILITY ANALYSIS OF THE NO-FUEL COMPRESSED AIR ENERGY STORAGE CONCEPT**
D. K. Kreid May 1976 71 p refs
(Contract E(45-1)-1830)
(BNWL-2065) Avail: NTIS HC A04/MF A01

The analysis uncovered no insurmountable problems to preclude the technical feasibility of the no-fuel compressed air energy storage concept. The results of the economic analysis are sufficiently unfavorable to conclude that no-fuel compressed air energy storage technology could not compete with conventional compressed air energy storage or standard gas turbine peaking facilities for conditions foreseeable at this time. ERA

**N77-19644#** California Univ., Berkeley. Lawrence Berkeley Lab.
**ENGINEERING EVALUATION OF SOLID TRANSITION-METAL SULFIDE ELECTRODES FOR USE IN HIGH ENERGY-DENSITY BATTERIES**
B. A. Marmaduke and L. F. Donaghey Jun. 1976 5 p refs Presented at 11th Intersoc. Energy Conversion Eng. Conf., State Line, Nev., 12 Sep. 1976
(Contract W-7405-eng-48)
(LBL-5186; Conf-760906-19) Avail: NTIS HC A02/MF A01

Solid electrode materials exhibiting anomalously high alkali ion diffusivities through layered structures were investigated for application in high-energy-density, fast-discharge-rate batteries. The maximum storage capacity and maximum discharge rates were studied theoretically for a spectrum of transition metal sulfides which crystallize in the CdI2 and MoS2 structures. Simple criteria were established for screening potentially important solid electrode materials for battery applications. ERA

**N77-19645#** California Univ., Livermore. Lawrence Livermore Lab.
**COMPOSITE FIBER FLYWHEEL FOR ENERGY STORAGE**
J. A. Rinde, T. T. Chiao, and R. G. Stone 4 Jun. 1976 21 p refs Presented at 8th Soc. for the Advan. of Mater. and Process Eng. Tech. Conf., Seattle, 12-14 Oct. 1976
(Contract W-7405-eng-48)
(UCRL-78085; Conf-761018-1) Avail: NTIS HC A02/MF A01

Key portable and stationary applications of the flywheel are discussed and examples of those presently under consideration are described in some detail. Design data on key candidate composite material systems are reported and areas that require further extensive study are also discussed. GRA

**N77-19646#** Sandia Labs., Albuquerque, N.Mex.
**DISTRIBUTION OF DIRECT AND TOTAL SOLAR RADIATION AVAILABILITIES FOR THE USA**
Eldon C. Boes, Irving J. Hall, Richard R. Prairie, Robert P. Stromberg, and Herbert Anderson Aug. 1976 30 p refs Presented at Sharing the Sun: Solar Technol. in the Seventies, Winnipeg, Can., 15 Aug. 1976
(Contract E(29-1)-789)
(SAND-76-0411; Conf-760821-12) Avail: NTIS HC A03/MF A01

Maps and tables showing the availability of direct-normal radiation by month for the US are presented. The results indicate that there is more direct solar energy than has been generally believed; direct-normal radiation availability generally exceeds total-horizontal availability by about 60 percent in the winter. ERA

**N77-19647#** Sandia Labs., Albuquerque, N.Mex.
**PHOTOVOLTAIC ENERGY CONVERSION USING CONCENTRATED SUNLIGHT**
E. L. Burgess 1976 7 p refs Presented at 20th Ann. SPIE Technical Symp., San Diego, Calif., 23 Aug. 1976
(Contract E(29-1)-789)
(SAND-76-5759; Conf-760832-5) Avail: NTIS HC A02/MF A01

A development program is described which uses sunlight concentration techniques to effect an immediate reduction in cost-per-unit-power for photovoltaic systems in which solar cell cost dominates the total system cost. Current examples of concentrator solar cell technologies are single crystal silicon and gallium arsenide. Implementation of cost reductions by the use of sunlight concentration is not dependent on the development of low-cost, mass-production cell technologies but emphasizes high cell efficiency and low-cost concentrator systems. ERA

**N77-19648#** Atlas Corp., Santa Clara, Calif.
**DESCRIPTION OF THE SOLAR ENERGY R AND D PROGRAMS IN MANY NATIONS Final Report**
F. DeWinter, ed. and J. W. DeWinter, ed. Feb. 1976 298 p refs
(Contract E(04-3)-1122)
(SAN-1122-76-1) Avail: NTIS HC A13/MF A01

Descriptions of the Solar Energy R and D Programs of 32 countries, of the Organization of American States, of UNESCO, and of a number of private organizations are presented. The descriptions were solicited from the most reliable representatives known for the individual countries. ERA

**N77-19649#** Boeing Co., Seattle, Wash. Engineering and Construction Div.
**CENTRAL RECEIVER SOLAR THERMAL POWER SYSTEM. COLLECTOR SUBSYSTEM RESEARCH EXPERIMENTS Quarterly Technical Progress Report, 2 Jan. - 31 Mar. 1976**
20 Apr. 1976 92 p refs
(Contract E(04-3)-1111)
(SAN-1111-76-2; D277-10025-1; QTPR-2) Avail: NTIS HC A05/MF A01

A description of the detail design (DD) of research experiment hardware to support the 10 MW/sub e/ pilot plant preliminary design (PD) is presented. Additionally, test plans for assembly, integration, and array tests are summarized along with results of completed component/material tests. Research experiment DD and tests described herein were planned to provide design verification and supporting data, with hardware which either duplicates, or closely simulates the pilot plant PD baseline. ERA

**N77-19650#** IIT Research Inst., Chicago, Ill.
**WEATHERABILITY OF SOLAR ENERGY UTILIZATION MATERIALS: PRELIMINARY DISCUSSIONS**
J. E. Gilligan and J. Brzuskiewicz 1976 14 p refs Presented at Sharing the Sun: Solar Technology in the Seventies, Winnipeg, Canada, 15 Aug. 1976
(Contract E(11-1)-0578)
(CONF-760821-11) Avail: NTIS HC A02/MF A01

The initial efforts of a program of research and experimental testing are described in which the optical and physical performance of materials for use in solar energy utilization devices will be determined before and after exposure to outdoor weathering tests. Materials which are currently in use and others which are being considered or developed for these applications will be characterized and exposed to natural solar radiation. The

results of these tests, primarily the effects of outdoor exposure on optical and physical properties, will be compiled in a handbook, along with cost, availability and other pertinent information. ERA

**N77-19651#** Institute of Gas Technology, Chicago, Ill.
**ENERGY TRANSMISSION FROM OCEAN THERMAL ENERGY CONVERSION PLANTS**
A. Konopka, A. Talib, B. Yudow, N. P. Biederman, and B. Winer (Arthur D. Little, Inc., Cambridge, Mass.) 1976 10 p refs Presented at the 11th Intersociety Energy Conversion Engineering Conf., State Line, Nev., 12-17 Sep. 1976 Sponsored in part by NSF
(Contract E(49-18)-2426)
(CONF-760906-20) Avail: NTIS HC A02/MF A01

The transmission, by barge and pipeline, of gaseous hydrogen, liquid hydrogen, and ammonia, as energy carriers are compared with transmission of electricity in submarine cables from an ocean thermal energy conversion plant. Because hydrogen energy and electrical energy are not equivalent, comparison requires assuming the outputs are converted to a common form. The delivered cost and overall energy efficiency of hydrogen, ammonia, and electricity, as well as a discussion of the equipment, costs and efficiencies of converting hydrogen and ammonia into electricity, and ocean thermal energy conversion mechanical energy into hydrogen and ammonia are presented. Converting electricity to chemical commodities and energies was not assessed. ERA

**N77-19652#** Virginia Univ., Charlottesville. Dept. of Mechanical Engineering.
**ENGINEERING ANALYSIS AND TESTING OF WATER TRICKLE SOLAR COLLECTOR Progress Report, Jun. - Nov. 1975**
J. T. Beard Mar. 1976 18 p refs Sponsored by ERDA
(ORO-4927-76/1) Avail: NTIS HC A02/MF A01

An outdoor solar collector test facility has been designed and constructed. The facility will be used for the simultaneous testing of four Thomason 'SOLARIS' water trickle collector panels under different test conditions (angle of orientation, temperature, water flow rate, glazing design, etc.) with the same atmospheric exposure. As expected, the preliminary results indicate that 'SOLARIS' collectors have high collection efficiency under conditions where the inlet water temperature is near the ambient temperature. Comparisons are made with published results for traditional single and double glazed flat plate collectors. ERA

**N77-19653#** Technology and Economics, Inc., Cambridge, Mass.
**AN OVERVIEW AND CRITICAL EVALUATION OF THE RELATIONSHIP BETWEEN LAND USE AND ENERGY CONSERVATION, VOLUMES 1 AND 2**
W. Curtiss Priest and Kenneth M. Happy 2 Mar. 1976 467 p refs
(Contract FEA-CO-04-50250-00)
(PB-258876/2; FEA/D-76/237-Vol-1; FEA/D-76/237-Vol-2) Avail: NTIS HC A02/MF A01 CSCL 10A

The relationships between land use and energy use, are described, and the general types of policies and programs that federal, state and local governments can pursue to influence land use for energy conservation purposes are described. GRA

**N77-19654#** Technology and Economics, Inc., Cambridge, Mass.
**AN OVERVIEW AND CRITICAL EVALUATION OF THE RELATIONSHIPS BETWEEN LAND USE AND ENERGY CONSERVATION, EXECUTIVE SUMMARY**
W. Curtiss Priest and Kenneth M. Happy Mar. 1976 27 p
(Contract FEA-CO-04-50250-00)
(PB-258877/0; FEA/D-76/236) Avail: NTIS HC A03/MF A01 CSCL 10A

The interrelationships between land use patterns and energy conservation are assessed. The interrelationships between land and energy uses in a new conceptual framework are ordered, those nascent policies and research programs which have linked land use with energy conservation are evaluated, and, a prioritized research and action agenda for hastening energy conservation through the land use management mechanism is developed. GRA

**N77-19655#** Gordian Associates, Inc., New York.
**SUMMARY REPORT FEA REGIONAL MEETINGS ON IMPROVING POWERPLANT PRODUCTIVITY**
Aug. 1976 176 p refs
(Contract FEA-CO-04-50235-00)
(PB-258878/8; FEA/G-76/272) Avail: NTIS HC A09/MF A01 CSCL 10B

The meetings covered the following: (1) industry comment on the interagency task force on powerplant productivity's recommendations for improving productivity; (2) utility productivity goals and upgrading plans; (3) annual performance data on 390 megawatt and large fossil fired units; and (4) industry recommendations for actions which should be taken to improve powerplant performance. GRA

**N77-19656#** Kentucky Univ., Lexington. Inst. for Mining and Minerals Research.
**PROCEEDINGS OF THE 4TH ENERGY RESOURCE CONFERENCE**
O. J. Hahn, ed., Donald T. MacClellan, ed., and R. William DeVore, ed. Jun. 1976 136 p refs Conf. Proc. held at Lexington, Ky., 7-8 Jan. 1976
(PB-259123/8; IMMR19-PD14-76) Avail: NTIS HC A07/MF A01 CSCL 10A

The most recent information available on the rapidly changing energy resource picture, fuel policies, economics, and technical advances is presented. Topics covered include facilities siting, economic analyses, coal gas desulfurization, ERDA programs on coal conversion and utilization, transportation problems, and others. GRA

**N77-19657#** Colorado Energy Research Inst., Golden.
**NET ENERGY ANALYSIS: AN ENERGY BALANCE STUDY OF FOSSIL FUEL RESOURCES**
Apr. 1976 238 p refs
(Contract DI-14-01-0001-2156)
(PB-259158/4; DOI-OMPRA-76/02) Avail: NTIS HC A11/MF A01 CSCL 10A

Fossil fuels from resources in the ground are examined through production processes which deliver usable energy ready for consumption. The complete direct and indirect energies which must be used to produce energy from fossil fuels are considered, including the energies which drive or subsidize the production. Included are those energies used in the production of materials needed to build and operate the industrial production and transportation facilities which either directly produce energy or which indirectly provide energy or materials to the energy production processes. GRA

**N77-19658#** Colorado Energy Research Inst., Golden.
**NET ENERGY ANALYSIS: AN ENERGY BALANCE STUDY OF FOSSIL FUEL RESOURCES. SUMMARY REPORT**
Apr. 1976 73 p refs
(Contract DI-14-01-0001-2156)
(PB-259159/2; DOI-OMPRA-76/03) Avail: NTIS HC A04/MF A01 CSCL 10A

Industrial energy production in fossil fuels is examined with emphasis on the Western United States. Complete direct and indirect energies which must be used to produce energy from fossil fuels are included. These cover direct and indirect energies which drive or subsidize the production. Included are also those energies sequestered in materials needed to build and operate the industrial production and transportation facilities which either directly or indirectly are necessary for energy production. All steps in bringing fossil fuels from reserves in the ground to the point of end use are considered (exploration, extraction, conversion, and transportation). GRA

**N77-19659#** Air Force Academy, Colo. Dept. of Civil Engineering.
**SOLAR HEATING RETROFIT OF MILITARY FAMILY HOUSING Technical Report, Apr. 1973 - Jun. 1976**
Marshall W. Nay, Jr., Jon M. Davis, Roy L. Schmiesing, and William A. Tolbert Sep. 1976 293 p refs
(AD-A030843; FJSRL-TR-76-0008) Avail: NTIS HC A13/MF A01 CSCL 13/1

This interim technical report describes the programming, facility, acquisition and initial performance of the first retrofit

constructed solar-heated facility in the United States Air Force, the Solar Test House at the United States Air Force Academy. The Air Force civil engineer is responsible today for operating and maintaining approximately 150,000 units of military family housing. As is the case in the private sector, the Air Force civil engineer is experiencing higher operating and maintenance costs due to inflation. Just recently, operating costs have begun to exceed maintenance costs. Higher energy related utility costs are believed responsible for this. Accordingly, Air Force civil engineers are interested in investigating the use of alternate energy schemes such as solar energy for its real property, not only in response to inflation in energy costs but also in response to energy crisis scenarios for a number of reasons which include: providing a mechanism to help offset rising utility costs; providing a mechanism to help guarantee mission continuation at installations that have their normal sources of conventional fossil fuels curtailed; and contributing to the national objective of energy self-sufficiency. Significant work in solar energy is currently on-going in the private sector. This work effort involves the application of solar energy for space heating, domestic hot water heating and air conditioning. However, this work is predominantly in the new construction category. GRA

**N77-19660#** Stanford Univ., Calif. Center for Materials Research.

**SOLID ELECTROLYTE BATTERY MATERIALS Final Report, period ending 30 Jun. 1976**

Robert A. Huggins Sep. 1976 27 p refs
(Contract N00014-75-C-1056; NR Proj. 056-555)
(AD-A030627; SU-CMR-76-12) Avail: NTIS HC A03/MF A01 CSCL 11/3

This is the Final Report on this contract. Work involved the preparation and property measurements on a number of potential ionic conductors and mixed ionic-electronic conductors, as well as the investigation of a novel technique for the preparation of oxide solid electrolytes. Especially interesting were the results on several groups of new lithium ionic conductors. Author (GRA)

**N77-19661#** Denver Research Inst., Colo. Div. of Metallurgy and Materials Science.

**SOLID STATE HYDROGEN STORAGE MATERIALS FOR APPLICATION TO ENERGY NEEDS Final Technical Report, 1 Oct. 1973 - 31 Mar. 1976**

Charles E. Lundin and Franklin E. Lynch Aug. 1976 37 p refs
(Contract F44620-74-C-0020; ARPA Order 2552)
(AD-A031229; AFOSR-76-1124TR) Avail: NTIS HC A03/MF A01 CSCL 10/3

Six areas of study of solid state hydrogen storage materials were completed in the two and one half year study. These were (1) literature survey and field trips relating to studies of hydrogen storage materials, (2) safety characteristics of LaNi5 hydrides, (3) general hydriding characteristics of LaNi5, (4) study of kinetics of hydrogen desorption of LaNi5, (5) studies of new alloy systems, and (6) development of fundamental insights of hydriding and of predictive criteria for new and improved hydrides. The safety characteristics of LaNi5 were fully evaluated in terms of the properties of powders. Bulk powder properties determined were: ignition temperature, relative combustibility, flammability, shock sensitivity, impact sensitivity, spark sensitivity, and explosibility. Studies of dispersed dust clouds were conducted in which ignition temperature, minimum ignition energy, minimum explosive concentration, maximum explosive pressure, and maximum rate of pressure rise were determined. From these data, an index of explosibility was obtained, which indicated a 'weak' rating. The general hydriding characteristics included data on activation, effects of repetitive cycling, hysteresis effects, surface poisoning effects, and more precise pressure-temperature-composition relationships of the system than have been available in the literature. The kinetics of hydrogen desorption from LaNi5 hydride were established. The order, rate constant, and activation energy were determined. The effects of surface contamination were studed by exposure to air, oxygen, and moisture. Evaluation was conducted principally by the change in the kinetics of desorption of hydrogen. GRA

**N77-19662#** InterTechnology Corp., Warrenton, Va.

**FEASIBILITY OF MEETING THE ENERGY NEEDS OF ARMY BASES WITH SELF-GENERATED FUELS DERIVED FROM SOLAR ENERGY PLANTATIONS Final Report**

George C. Szego Jul. 1976 161 p refs
(Contract DACA23-74-C-0009; ARPA Order 2630)
(AD-A031163; ITC-260675) Avail: NTIS HC A08/MF A01 CSCL 10/1

This project thoroughly investigated the possibility of collecting and storing solar radiation in plants especially grown for their fuel value as a source of fuel on U. S. Army bases. The study investigated the merit of producing this fuel at energy plantations at or near the bases. The fuel would be used for directly fired steam generators, hot water heaters, space heaters, and cooking. The research examined the major characteristics of energy plantations; analyzed plant-matter production rates from deciduous plants; and examined fuel consumption in stationary facilities at major troop training centers. The possibilities and requirements of energy plantations at Fort Benning, Fort Leonard Wood, and at Army bases in general were detailed. It was concluded that energy plantations could be feasible at approximately 15 large Army bases and that the cost of solid fuel produced from them would be approximately $1/1 million Btu; the cost of synthetic natural gas produced from plants was determined to be approximately $3.10 to $4.20/1000 standard cu ft. Besides being a perpetually renewable fuel source, it was found that energy plantations could provide independence from other fuel sources, reduction in future environmental problems caused by present fuels, and will productively use land not now in active use. Author (GRA)

**N77-19663#** InterTechnology Corp., Warrenton, Va.

**FEASIBILITY OF MEETING THE ENERGY NEEDS OF ARMY BASES WITH SELF-GENERATED FUELS DERIVED FROM SOLAR ENERGY PLANTATIONS. APPENDIXES A, B, AND C Final Report**

George C. Szego Jul. 1976 325 p refs
(Contract DACA23-74-C-0009; ARPA Order 2630)
(AD-A031164; ITC-260675-App-A; ITC-260675-App-B; ITC-260675-App-C) Avail: NTIS HC A14/MF A01 CSCL 10/1

For abstract, see N77-19662.

**N77-19664#** Massachusetts Inst. of Tech., Cambridge. Dept. of Nuclear Engineering.

**ECONOMIC AND TECHNICAL ASPECTS OF GAS TURBINE POWER STATIONS IN TOTAL ENERGY APPLICATIONS Final Report**

Joseph Kelley and M. W. Golay 30 Jan. 1976 124 p refs
(Contract DAAK02-74-C-0308; DA Proj. 4A7-62719-AT-41)
(AD-A031236; USAFESA-RT-2013) Avail: NTIS HC A06/MF A01 CSCL 10/2

This report summarizes a study of gas turbine power plant options which will be available in 1985 for use in total energy system applications. The gas turbines examined are of the aircraft derivative and industrial types. If coal were used as the fuel combustion chamber modification for use of low-BTU gasified coal in the power plant would be required. Such power plants could be controlled by means of the standard fuel control method, although turbine bypass control would also be possible. For total energy applications it would be necessary to replace the steam boiler of the steam bottoming cycle which is currently used in such applications with a high temperature water heat exchanger; however, such a design change would not be difficult to implement. Aircraft derivative turbines are more expensive but easier to maintain, transport, and repair, and are amenable to design of a more reliable power station than industrial turbines. On that basis, the former turbine type is judged to be preferable for military installation total energy applications. Author (GRA)

**N77-19665#** Colorado State Univ., Fort Collins. Dept. of Agricultural Engineering.

**WIND POWERED AERATION FOR REMOTE LOCATIONS Progress Report, 15 Mar. 1975 - 15 Mar. 1976**

Paul M. Schierholz, Willis L. Somervell, Jr., William Babcock (Colo. Div. of Wildlife, Ft. Collins), Richard Hartel (Colo. Div. of Wildlife, Ft. Collins), and Keith Watson Apr. 1976 74 p
(Contract NSF AER-75-00833)
(PB-259304/4; NSF/RA-760238) Avail: NTIS HC A04/MF A01 CSCL 13B

The use of wind power directly to compress air to increase oxygen levels in polluted rivers and lakes, subject to winterkill, was studied. A prime advantage may be using the water for storage of oxygen, eliminating requirements for energy storage such as batteries. Sites proposed for the installation of wind powered systems include a lake chosen on the high plains for ease of access, high mountain lake subject to winterkill, and a high plains river with pollution problems. GRA

**N77-19666#** Failure Analysis Associates, Palo Alto, Calif.
**FAILURE ANALYSIS AND FAILURE PREVENTION IN ELECTRIC POWER SYSTEMS Final Report**
Charles A. Rau, Jr., Philip M. Besuner, Groffrey R. Egan, Duane P. Johnson, Alan S. Tetelman, David G. Becker, Russell C. Cipola, Prem Gupta, Ur Omry, and Terry W. Rettig Nov. 1976 256 p refs Sponsored by EPRI
(PB-261471/7; EPRI-NP-280) Avail: NTIS HC A12/MF A01 CSCL 10B

Present and potential problem areas have been identified both by development of an improved computerized data base of malfunctions in nuclear power plants and by detailed metallurgical and mechanical failure analyses of selected problems. Mathematical methods have also been developed to describe and analyze the statistical variations in materials properties and in component loading, and uncertainties in the flaw size that might be passed by quality assurance systems. These new methods have been combined to develop accurate failure rate predictions based upon probabilistic fracture mechanics. GRA

**N77-19667#** Institute of Gas Technology, Chicago, Ill.
**WIND-POWERED HYDROGEN ELECTRIC SYSTEMS FOR FARM AND RURAL USE Final Report, May - Dec. 1975**
Raymond R. Tison, Nicholas P. Biederman, Timothy Donakowski, Robert H. Elkins, Jon B. Pangborn, Mark A. Turnquist, Richard Young, and Bernie Yudow Apr. 1976 171 p refs Sponsored in part by ERDA
(Grant NSF AER-75-00772)
(PB-259318/4; NSF/RA-760184) Avail: NTIS HC A08/MF A01 CSCL 10B

Two methods of energy storage are evaluated for use and subsequently form the bases upon which each design is optimized. It is shown that wind-energy systems based on battery-storage systems are: (1) simpler to construct and maintain; (2) more efficient; and (3) less expensive than those based on hydrogen-storage systems. Further, the relative economics of each wind-energy system are heavily dependent on wind availability, number of days of energy storage required, and the match between the wind energy available and the energy requirement of the load. Of all the energy requirements characterized, the cash grain operation is shown to be the least adaptable to wind-energy systems. GRA

**N77-19668#** Peat, Marwick, Mitchell and Co., Washington, D.C.
**ENERGY AND ECONOMIC IMPACTS OF PROJECTED FREIGHT TRANSPORTATION IMPROVEMENTS Final Report**
R. H. Leilich, R. D. Cohen, A. Gezen, and M. V. Kendrick Nov. 1976 442 p Prepared in cooperation with Battelle Columbus Labs., Ohio
(Contract DOT-TSC-0094-18)
(PB-260000/5; DOT-TSC-OST-76-61) Avail: NTIS HC A19/MF A01 CSCL 10A

The report discusses in detail operational and technological changes which will have energy and economic impacts on freight modes. GRA

**N77-19669#** Opinion Research Corp., Princeton, N.J.
**BARRIERS TO ENERGY CONSERVATION**
Jul. 1976 69 p refs
(Contract FEA-CO-04-5174-01)
(PB-259812/6; FEA/D-76/296; Paper-55) Avail: NTIS HC A04/MF A01 CSCL 10A

The various ways in which economic barriers affect efficient energy usage are discussed. The study is concerned only with the energy used by finished products and not with the energy used in the production process itself. GRA

**N77-19112*#** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**COMPUTER MODELING OF A REGENERATIVE SOLAR-ASSISTED RANKINE POWER CYCLE**
F. L. Lansing *In its* The Deep Space Network 15 Feb. 1977 p 152-168 refs (For primary document see N77-19091 10-12)
Avail: NTIS HC A13/MF A01 CSCL 10A

## 45 ENVIRONMENT POLLUTION

Includes air, noise, thermal and water pollution; environment monitoring; and contamination control.

**N77-19670#** Ames Lab., Iowa.
**ANALYTICAL LINES FOR LONG-PATH INFRARED ABSORPTION SPECTROMETRY OF AIR POLLUTANTS USING DIODE LASERS M.S. Thesis**
B. M. Golden Jun. 1976 85 p refs
(Contract W-7405-eng-82)
(IS-T-708) Avail: NTIS HC A05/MF A01

A scheme for selecting resonant frequencies for the analysis of gaseous air pollutants using long-path absorption of narrow-band infrared sources is presented. A computer search is conducted using existing spectrometric data to determine lines with minimum interference and maximum sensitivity. Results are given for the pollutants O3, N2O, CO, CH4, and the non-polluting species, H2O and CO2. In addition, accurate absorption line half-widths of NO were determined using a conventional high resolution infrared spectrometer and modern data taking procedures. ERA

**N77-19671#** Battelle Pacific Northwest Labs., Richland, Wash.
**APPLIED SYSTEM ECOLOGY: MODELS, DATA, AND STATISTICAL METHODS**
L. L. Eberhardt 1976 48 p refs Presented at Summer Computer Simulation Conf., Washington, D. C., 12 Jul. 1976 Revised
(Contract AT(45-1)-1830)
(BNWL-SA-5216-Rev; Conf-760703-7) Avail: NTIS HC A03/MF A01

Systems ecology is largely equated to mathematical or computer simulation modelling. The best predictive devices may be regression equations, often non-linear in form, extracted from much more detailed models. A variety of statistical aspects of modelling, including sampling, are discussed. Several aspects of population dynamics and food-chain kinetics are described, and it is suggested that the two presently separated approaches should be combined into a single theoretical framework. It is concluded that future efforts in systems ecology should emphasize actual data and statistical methods, as well as modelling. ERA

**N77-19672#** Brookhaven National Lab., Upton, N.Y.
**AEROSOL GROWTH MEASUREMENTS USING THE DIFFERENTIAL 2 AND CLIMET 208 LIGHT SCATTERING SPECTROMETERS**
I. N. Tang, H. R. Munkelwitz, and J. B. Davis 1976 19 p refs Presented at Aerosol Meas. Workshop, Gainesville, Fla., 23 Mar. 1976; sponsored by Triangle Univ. Consortium on Air Pollution, ERDA and Fla. Univ.
(Contract E(30-1)-16)
(BNL-21432; Conf-760349-1) Avail: NTIS HC A02/MF A01

Experimental techniques developed for a study of aerosol growth by water-vapor condensation are described. Two types of experiments were performed in separate systems. In one apparatus, which employed a modified Climet 208 particle analyzer to continuously monitor particle size distributions, the growth of a monodisperse sodium chloride aerosol was investigated as a function of relative humidity. The critical humidity at which solid NaCl particles transform into solution droplets was determined. In another apparatus, the phase transition of a single sodium chloride particle was followed using a particle spectrometer. It is demonstrated that with appropriate modifications the two commercially available optical instruments are well suited for laboratory studies of aerosol growth. ERA

**N77-19673#** Oak Ridge National Lab., Tenn.
**DETERMINING EMISSIONS MEASUREMENTS NEEDS FOR AN EMERGING INDUSTRY-ADVANCED FOSSIL FUELS UTILIZATION**

M. R. Guerin and J. L. Epler 17 Jun. 1976 30 p refs Presented at 1st Conf. on Determining Fugitive Emission Meas. Needs, Hartford, 17-19 May 1976 Sponsored jointly by ERDA and EPA
(CONF-760563-1) Avail: NTIS HC A03/MF A01

The existence or extent of environmental and health problems related to coal gasification or liquefaction plants cannot be determined at present because commercial scale plants do not exist. Few processes have yet reached the demonstration plant scale. Methods are required, however, to quickly and reliably assess the extent of the problem as large scale operations are initiated. Data generated in the course of methods development may also be useful in designing control technologies. One approach to establishing reliable methods and generating data of value in setting priorities on environmental and health studies is presented. Measurements needs are identified through an experimental assessment of existing methods. ERA

**N77-19674#** Sandia Labs., Livermore, Calif.
**NITROGEN OXIDE FORMATION FROM CHEMICALLY-BOUND NITROGEN DURING THE COMBUSTION OF FOSSIL FUELS**
R. E. Mitchell Jun. 1976 25 p refs
(Contract AT(29-1)-789)
(SAND-76-8227) Avail: NTIS HC A02/MF A01

The conversion of chemically-bound nitrogen to NOx during fossil fuel combustion depends upon such factors as the nitrogen content of the fuel and the equivalence ratio and upon the physical processes governing combustion. Research is proposed to establish the kinetic processes involved in the conversion of fuel nitrogen to NO and N2 in environments characteristics of fossil fuel combustion and to identify those conditions which favor the reduction of NO to N2. ERA

**N77-19675#** Battelle Pacific Northwest Labs., Richland, Wash.
**REGIONAL STUDIES PROGRAM WORKSHOP ON AIR QUALITY AND METEOROLOGICAL ASSESSMENTS**
David S. Renne Jun. 1976 31 p refs Workshop held at Richland, Wash., 9-10 Mar. 1976
(Contract E(45-1)-1830)
(BNWL-2062) Avail: NTIS HC A03/MF A01

A Regional Studies Program Workshop on Air Quality and Meteorological Assessments was held at the Battelle-Northwest Auditorium on March 9-10, 1976. Approximately twenty-three participants, including representatives from several laboratories, the Energy Research and Development Administration and a Washington State publicly owned utility, exchanged technical and philosophical views on their approach to performing assessments under Regional Studies Program. Discussions included the technical approach under way at each laboratory, assessment objectives and techniques, and data needs and availability. ERA

**N77-19676#** Exxon Research and Engineering Co., Linden, N.J.
**MECHANISM AND KINETICS OF THE FORMATION OF NOx AND OTHER COMBUSTION POLLUTANTS. PHASE 1: UNMODIFIED COMBUSTION Final Report, Apr. 1973 - Feb. 1974**
V. S. Engleman and W. Bartok Aug. 1976 310 p refs
(Contract EPA-68-02-0224)
(PB-258874/7; GRU.2DJAM.76; EPA-600/7-76-009-a) Avail: NTIS HC A14/MF A01 CSCL 13B

Phase 1 results are given of an investigation of the mechanisms and kinetics of the formation of NOx and other combustion pollutants. Results are also given of experimental investigations of unmodified combustion and supporting theoretical calculations. The combustion of hydrogen, carbon monoxide, methane, and propane with air in a jet-stirred combustor (JSC) was studied to facilitate the assessment of coupled combustion/pollutant formation. The JSC tests also extended the range and accuracy of data taken in previous studies. Experiments also included a flow reactor capable of accepting multiple burner types and operating with selected wall temperature. Premixed flat and focused flames, as well as laminar and turbulent diffusion flames, were studied in the flow reactor using methane and propane fuels. The tests included heat-loss and adiabatic conditions and a limited number of wall heat addition cases. GRA

**N77-19677#** Exxon Research and Engineering Co., Linden, N.J.
**MECHANISM AND KINETICS OF THE FORMATION OF NOx AND OTHER COMBUSTION POLLUTANTS. PHASE 2: MODIFIED COMBUSTION Final Report, Feb. 1974 - Dec. 1975**
V. S. Engleman, V. J. Siminski, and W. Bartok Aug. 1976 175 p refs
(Contract EPA-68-02-0224)
(PB-258875/4; GRU.3DJAM.76; EPA-600/7-76-009-b) Avail: NTIS HC A08/MF A01 CSCL 13B

Two experimental devices were used. A special flat-flame burner with a controlled-temperature post-flame zone was used to investigate combustion modification techniques used to control NOx emissions: staged combustion, water addition, exhaust gas recirculation, and degree of air preheat. Augmenting the combustion testing, a novel flow reactor--the adiabatic stirred combustor (ASC)--was built. This new device allowed kinetic studies unhindered by mixing or heat transfer limitations. The comparisons showed strong interaction between hydrocarbon species and molecular nitrogen near stoichiometric and fuel-rich conditions. GRA

**N77-19678#** Naval Postgraduate School, Monterey, Calif.
**AN AMBIENT AIR QUALITY MODEL FOR ASSESSMENT OF US NAVAL AVIATION EMITTANTS Final Report**
Gary Thompson and David W. Netzer Sep. 1976 105 p refs
(AD-A030031; NPS-67N/76091) Avail: NTIS HC A06/MF A01 CSCL 13/2

An air quality assessment model for U.S. Naval aircraft operations was developed from a generalized air quality assessment model for U.S. Air Force operations. Data were gathered by observation of operations at a Naval Air Station and these data used to conduct parametric studies to demonstrate the capabilities of the model. Modifications to the original model and these parametric studies are discussed. Author (GRA)

**N77-19679#** Army Chemical Center, Edgewood, Md. Directorate of Development and Engineering.
**DEVELOPMENT OF A KIT FOR DETECTION OF HAZARDOUS MATERIAL SPILLS INTO WATERWAYS Special Publication, Jun. 1974 - Jun. 1976**
Achille Silvestri, Alan Goodman, Lawrence M. McCormack, Marie K. Razulis, Arthur R. Jones, Jr., and Michael E. P. Davis Aug. 1976 91 p refs
(AD-A030610; ED-SP-76023) Avail: NTIS HC A05/MF A01 CSCL 13/2

Edgewood Arsenal has developed a kit to detect hazardous material spills into waterways. The purpose of the program was to develop a man-portable field kit able to detect (not necessarily identify) as many contaminants in water in as low a concentration as possible. A field kit was designed containing a spectrophotometer, conductivity meter, pH meter and a variety of accessory equipment and reagents. Prototype kits were fabricated and delivered to the Environmental Protection Agency along with engineering drawings, parts lists and manuals. GRA

**N77-19680#** Army Medical Intelligence and Information Agency, Washington, D.C.
**MAXIMUM PERMISSIBLE CONCENTRATIONS OF ATMOSPHERIC POLLUTANTS**
N. F. Izmerov 8 Sep. 1976 23 p refs Transl. into ENGLISH of "Predel no dopustimyye kontsentratsii armosferykh zagryaznen-iy" Moscow, Medyiz, 1961 p 3-4, 73-93
(AD-A030557; USAMIIA-K-6558) Avail: NTIS HC A02/MF A01 CSCL 13/2

Chronic exposure to Galosha naphtha vapor in a concentration of 106.5 mg cu m for 5 months for 6 hours a day causes functional changes of the conditioned reflexive activity in experimental animals that build in proportion to exposure and appear two weeks after terminating exposure. The reflex action of Galosha naphtha vapor on light sensitivity of the eye is only observed at a concentration of 56 mg/cu m or higher. The most sensitive indicator for establishing the maximum permissible concentration of gasoline vapor in atmospheric air is the threshold of odor. Taking into account the need for a certain reserve factor and the slight difference in the threshold of odor for the investigated types of gasoline, one can recommend 5 mg/cu m (in recalulation for carbon) as the maximum single permissible

concentration for the types of low sulfur petroleum gasoline. GRA

**N77-19681#** Environmental Protection Agency, Washington, D.C. Office of Research and Development.
**SECOND JOINT US/USSR SYMPOSIUM ON THE COMPREHENSIVE ANALYSIS OF THE ENVIRONMENT**
Oct. 1976 174 p refs Conf. held at Honolulu, Hawaii, 21-26 Oct. 1975
(PB-259520/5; EPA-600/9-76-024) Avail: NTIS HC A08/MF A01 CSCL 13B

Papers presented were grouped into the following categories: maximum permissible load; internal substance cycling in natural ecosystems; human risk assessment; and environmental stress and behavior. GRA

**N77-19682#** Pacific Northwest Environmental Research Lab., Corvallis, Ore. Terrestrial Ecology Branch.
**ECOLOGICAL EFFECTS OF AEROSOL DRIFT FROM A SALTWATER COOLING SYSTEM Final Report**
Ibrahim J. Hindawi, Lawrence C. Raniere, and James A. Rea Jul. 1976 117 p refs
(PB-258831/7; EPA-600/3-76-078) Avail: NTIS HC A06/MF A01 CSCL 13B

The local terrestrial effects of salt aerosol drift from powered spray modules and a mechanical draft cooling tower at Turkey Point, Florida were evaluated through field and controlled exposure studies. Indigenous vegetation, soil and fresh water were sampled over a year long period to acquire pre-activation baseline data and to provide for the assessment of possible environmental impacts of salt aerosol loading from the test cooling devices. No measurable effects attributable to salt aerosol emissions from test cooling devices were detected on indigenous plants, soil or fresh water sampled during or following operation of the test cooling tower/spray modules. Full term effects and salt aerosol tolerance levels of a cultivar plant, bush bean, were examined by controlled exposure to a simulated sea salt aerosol at concentrations representative of the Turkey Point test site. GRA

**N77-19683#** Booz-Allen Applied Research, Inc., Bethesda, Md.
**POTENTIAL ENVIRONMENTAL IMPACTS OF SOLAR HEATING AND COOLING SYSTEMS Final Report**
T. J. Consroe, F. M. Glaser, and R. W. Shaw, Jr. Oct. 1976 124 p refs
(Contract EPA-68-01-2942)
(PB-259970/2; BAAR-9075-043-001; EPA-600/7-76-014) Avail: NTIS HC A06/MF A01 CSCL 13A

Potential environmental consequences of solar energy utilization for heating and cooling buildings are discussed. Areas in which both positive and negative impacts are possible are identified, the national research and development program directed toward solar heating and cooling technology is summarized, and a general methodology for estimating the impact on air pollution of solar energy utilization in urban areas is presented. GRA

**N77-19684#** Arkansas Univ., Fayetteville. Water Resources Research Center.
**AN AQUEOUS ENVIRONMENTAL SIMULATION MODEL FOR MID-SOUTH LAKES AND RESERVOIRS**
Louis J. Thibodeaux 1976 93 p refs Submitted for publication.
(Contract DI-14-34-0001-6058)
(PB-259539/5; W77-00675; Pub-41; OWRT-A-026-ARK(3)) Avail: NTIS HC A05/MF A01 CSCL 13B

Quantitative relationships and associated computer program were developed to simulate some of the major physical, chemical and biological processes occurring within the aqueous phase of lakes and reservoirs. The model was developed, in part, to study the eutrophic development of these water bodies. Emphasis is upon lakes in the Mid-South U.S.A. The physical model reflects the general environment in this region and includes a single stratified period. The chemical subsystem includes phytoplankton, zooplankton, omnivorous fish, carnivorous fish and aerobic bacteria. The model was adjusted to field data from Beaver Reservoir in Northwest Arkansas. GRA

**N77-19685#** Rhode Island Univ., Kingston. Dept. of Civil and Ocean Engineering.
**DEVELOPMENT OF A SYSTEM TO DETECT AND MONITOR SEDIMENT POLLUTION Technical Completion Report, 1 Jul. 1974 - 30 Jun. 1976**
Vito A. Nacci 1976 23 p refs
(Contract DI-14-34-0001-5040)
(PB-259265/7; W77-00539) Avail: NTIS HC A02/MF A01 CSCL 13B

A modified electrical resistivity device was used to study laboratory and offshore sediment pollution. In the laboratory, several different soil types saturated in a simulated sea water with or without different pollutants, including soap, fertilizer, pesticide, paint, and fuel oil were used for investigation. The laboratory study results indicated that the presence of the pollutants in a considerable change in the electrical resistivity of the sediment. A field electrical resistivity study gave sediment pollution distribution in good agreement with that obtained from laboratory analysis of core samples. GRA

**N77-19686#** Alaska Univ., College. Inst. of Water Resources.
**USER'S GUIDE FOR ATMOSPHERIC CARBON MONOXIDE TRANSPORT MODEL Final Report**
Robert F. Carlson (Resource Management Association, Inc., Lafayette, Calif.) and William R. Norton Jun. 1976 160 p Sponsored by State of Alaska Dept. of Highways Prepared in cooperation with the FHWA, Washington, D. C.
(PB-259719/3; IWR-76; FHWA-AK-76-IWR76) Avail: NTIS HC A08/MF A01 CSCL 13B

In the winter months of Fairbanks, Alaska, a highly stable air temperature inversion creates high levels of carbon monoxide (CO) concentrations. As an aid to understanding this problem, a CO transport computer model has been created which provides a useful tool when used in conjunction with other measurement and analytic studies of traffic, meteorology, emissions control, zoning, and parking management. The model is completely documented and illustrated with several examples. Named ACOSP (Atmospheric CO Simulation Program), it predicts expected CO concentrations time, the model is programmed to consider automobile emissions as the major CO source. GRA

**N77-19687#** Oklahoma State Univ., Stillwater. Dept. of Agricultural Engineering.
**IMPROVING THE QUALITY OF WATER RELEASES FROM RESERVOIRS BY MEANS OF A LARGE DIAMETER PUMP Final Technical Report, 1 Sep. 1973 - 31 Mar. 1976**
James E. Garton and Charles E. Rice Mar. 1976 36 p refs
(Contract DI-14-31-0001-4215)
(PB-259548/6; W77-00668; OWRT-C-5228(4215)(1)) Avail: NTIS HC A03/MF A01 CSCL 13B

A low energy destratifier using 42-inch propellers to pump the water downward from the surface has been used successfully to destratify a 100 acre lake for 3 years. This project was an attempt to apply the same kind of device to Lake Arbuckle, a 2400 acre, 90-feet deep lake in south central Oklahoma. A 16.5-foot aircraft propeller was used to pump approximately 200,000 gallons per minute downward. Although the lake stability index was decreased by half, a corresponding reduction in the oxygen distribution index did not occur until the fall overturn. The oxygen content in the outlet waters near the pump was increased 1 to 2 mg/l during the critical summer months. GRA

**N77-19688#** Energy Resources Co., Inc., Cambridge, Mass.
**POTENTIAL ENVIRONMENTAL CONSEQUENCES OF TERTIARY OIL RECOVERY Final Report, Jun. 1975 - Apr. 1976**
C. Braxton, R. Stephens, C. Muller, and J. White Jul. 1976 229 p refs
(Contract EPA-68-01-1912)
(PB-260646/5) Avail: NTIS HC A11/MF A01 CSCL 08I

Potential environmental problems associated with enhanced oil recovery methods (micellar-polymer flooding, polymer flooding, surfactant flooding, hydrocarbon miscible displacement, carbon dioxide miscible displacement, steam displacement (or drive), cyclic steam stimulation, and in-situ combustion (or fireflooding)) are identified. Possible impacts on ambient air quality, groundwater supplies and water quality are assessed qualitatively, and where possible quantitatively, using dispersion modeling and risk estimates. Those potential problems which are unique to enhanced

oil recovery as well as post-operational problems such as chemical degradation products, are examined. GRA

# 46 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; ionospheric and magnetospheric physics; and geomagnetism.

For space radiation see *93 Space Radiation*.

**N77-19689#** Lockheed Missiles and Space Co., Palo Alto, Calif.
**BEHAVIOR OF HIGH-ENERGY ELECTRONS OF THE RADIATION BELTS DURING RESONANCE INTERACTION WITH GEOMAGNETIC PULSATIONS**
B. I. Meerson [1976] 7 p refs Transl. into ENGLISH from Geomagn. i Aeron. (USSR), v. 16, no. 6, 1976 p 1072-1077
Avail: NTIS HC A02/MF A01; National Translation Center, John Crerar Library, Chicago, Illinois 60616

The influence of geomagnetic pulsations with discrete frequencies on the high-energy electrons captured by the geomagnetic field is investigated. The contribution of resonance interaction to the effect of electron dumping in the dense layers of the atmosphere is determined. Author

**N77-19690*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**NEW FEATURES OF GLOBAL CLIMATOLOGY REVEALED BY SATELLITE-DERIVED OCEANIC RAINFALL MAPS**
M. S. V. Rao (Systems and Appl. Sci. Corp.) and J. S. Theon Jan. 1977 12 p refs
(NASA-TM-X-71275; X-911-77-19) Avail: NTIS HC A02/MF A01 CSCL 04A

Quantitative rainfall maps over the oceanic areas of the globe were derived from the Nimbus 5 Electrically Scanning Microwave Radiometer (ESMR) data. Analysis of satellite derived oceanic rainfall maps reveal certain distinctive characteristics of global patterns for the years 1973-74. The main ones are (1) the forking of the Intertropical Convergence Zone in the Pacific, (2) a previously unrecognized rain area in the South Atlantic, (3) the bimodal behavior of rainbelts in the Indian Ocean and (4) the large interannual variability in oceanic rainfall. These features are discussed. Author

**N77-19691*#** National Aeronautics and Space Administration. Wallops Station, Wallops Island, Va.
**ABSOLUTE RAYLEIGH SCATTERING CROSS SECTIONS OF GASES AND FREONS OF STRATOSPHERIC INTEREST IN THE VISIBLE AND ULTRAVIOLET REGIONS**
Shardanand and A. D. Prasad Rao (Computer Sci. Corp., Wallops Island, Va.) Washington Mar. 1977 39 p refs
(NASA-TN-D-8442) Avail: NTIS HC A03/MF A01 CSCL 04A

The laboratory measurements of absolute Rayleigh scattering cross sections as a function wavelength are reported for gas molecules He, Ne, Ar, N2, H2, O2, CO2, CH4 and for vapors of most commonly used freons CCl2F2, CBrF3, CF4, and CHClf2. These cross sections are determined from the measurements of photon scattering at an angle of 54 deg 44 min which yield the absolute values independent of the value of normal depolarization ratios. The present results show that in the spectral range 6943-3638A deg, the values of the Rayleigh scattering cross section can be extrapolated from one wavelength to the other using 1/lambda (4) law without knowing the values of the polarizabilities. However, such an extrapolation can not be done in the region of shorter wavelengths. Author

**N77-19692*#** Drexel Univ., Philadelphia, Pa. Dept. of Physics and Atmospheric Science.
**TECHNIQUES FOR OBTAINING REGIONAL RADIATION BUDGETS FROM SATELLITE RADIOMETER OBSERVATIONS, PHASE 4 AND PHASE 5 Ph.D. Thesis. Final Report**
Jose F. Pina and Frederick House Dec. 1976 218 p refs
(Contract NAS1-11871)
(NASA-CR-145129) Avail: NTIS HC A01/MF A01 CSCL 04A

A scheme was developed which divides the earth-atmosphere system into 2060 elemental areas. The regions previously described are defined in terms of these elemental areas which are fixed in size and position as the satellite moves. One method, termed the instantaneous technique, yields values of the radiant emittance (We) and the radiant reflectance (Wr) which the regions have during the time interval of a single satellite pass. The number of observations matches the number of regions under study and a unique solution is obtained using matrix inversion. The other method (termed the best fit technique), yields time averages of We and Wr for large time intervals (e.g., months, seasons). The number of observations in this technique is much greater than the number of regions considered, and an approximate solution is obtained by the method of least squares. Author

**N77-19693#** Massachusetts Inst. of Tech., Cambridge. Dept. of Meteorology.
**ENERGETICS AND DYNAMICS OF THE STRATOSPHERE**
Reginald E. Newell and William R. Tahnk (AFGL) 1976 78 p refs Presented at Ann. Meeting of Am. Assoc. for the Advan. of Sci., Boston, 18-24 Feb. 1976
(Contract E(11-1)-2195)
(COO-2195-23; Conf-760217-14) Avail: NTIS HC A05/MF A01

Current problems are outlined that emerge from diagnostic studies of the energy, momentum and mass budgets of the stratosphere. The temperature field maintained by radiative and dynamic processes, and the wind field maintained was studied. The causes of large changes in the temperature and circulation in late winter, as well as an ozone maximum associated with these changes was analyzed. ERA

**N77-19694#** Los Alamos Scientific Lab., N.Mex.
**MAGNETOTAIL: ITS GENERATION AND DISSIPATION**
E. W. Hones, Jr. 1976 15 p refs Presented at Intern. Symp. on Solar Terrest. Phys., Boulder, Colo., 7 Jun. 1976
(Contract W-7405-eng-36)
(LA-UR-76-1301; Conf-760645-1) Avail: NTIS HC A02/MF A01

The kinetics of the magnetotail generation and dissipation are considered. ERA

**N77-19695#** Utah Univ., Salt Lake City. Dept. of Meteorology.
**EFFECT OF A SINUSOIDAL WAVE ON DIFFUSION FROM AN INFINITE LINE SOURCE**
S. K. Kao, J. Paegle, and R. D. Youngblood Jan. 1976 25 p refs Presented at Symp. on Atmos. Turbulence, Diffusion, and Air Quality, Raleigh, N. C., 19 Oct. 1976
(Contract E(11-1)-2455)
(COO-2455-12; Conf-761003-8) Avail: NTIS HC A02/MF A01

Sinusoidal vertical motion effects on turbulent diffusion are analyzed using models (1) without vertical motion, (2) with a simple sinusoidal vertical motion of constant amplitude, and (3) with a sinusoidal vertical motion of damping amplitude. It is found that the presence of undulations in vertical velocity significantly enhances the dispersion of pollution. Comparison of effective diffusivity shows an increase by a factor of 3.9 where no damping of undulations occurred, and by a factor of 2.8 where we have a damping of the undulation below the level of the source. Increase in dispersion is explained by the fact that the undulations created a dilution in concentration because of the vertical motion and a configuration in which horizontal diffusivity is allowed to have an effect in pulling pollutant away from the axis of maximum concentration. ERA

**N77-19696#** Joint Inst. for Lab. Astrophysics, Boulder, Colo.
**PHOTODETACHMENT STUDIES OF MOLECULAR NEGATIVE IONS Final Report, 1 Jul. 1973 - 30 Jun. 1976**
E. C. Beaty and W. C. Lineberger 23 Sep. 1976 14 p refs
(Grant DA-ARO(D)-31-124-73-G208; DAHC04-75-G-0024)
(AD-A031059; ARO-11892.2-P) Avail: NTIS HC A02/MF A01 CSCL 04/1

A drift tube mass spectrometer and an ion beam machine have been used with a flashlamp pumped tunable dye laser to study photodestruction of atmospheric molecular negative ions. Results are presented for O2-, O3-, CO3-, and NO2-. Problems

inherent with the technique and possible improvements are discussed. Author (GRA)

**N77-19697#** Naval Research Lab., Washington, D.C.
**ELECTRON IMPACT RATE COEFFICIENTS FOR THE LOW LYING METASTABLE STATES OF O, O+, N AND N+ Interim Report**
A. W. Ali Sep. 1976 20 p refs
(DNA Proj. NWED-QAXHD010)
(AD-A031221; NRL-MR-3371) Avail: NTIS HC A02/MF A01 CSCL 04/1

A set of electron impact excitation rate coefficients for the low lying metastable states of O, N, O(+), and N(+) are presented. These rates are obtained using recent and more accurate cross sections. These species play an important role in the emission, deionization processes and communication problems of a disturbed atmosphere. Author (GRA)

**N77-19698#** Army Electronics Command, Fort Monmouth, N.J.
**STRATOSPHERIC WIND SHEAR COMPUTED FROM SATELLITE THERMAL SOUNDER MEASUREMENTS**
Louis D. Duncan Sep. 1976 19 p refs
(DA Proj. 1T1-62111-AH-71)
(AD-A031222; ECOM-5800) Avail: NTIS HC A02/MF A01 CSCL 04/1

The successful operation of thermal sounders on meteorological satellites has provided the atmospheric scientist with a new tool for observing atmospheric structures. This report discusses the application of these measurements to determination of wind shears in the altitude range of 15 to 30 km. During calendar year 1975 an experiment was conducted at White Sands Missile Range (WSMR), NM, to determine the feasibility of using thermal sounder data to compute stratospheric wind shear. Radiosonde observations were taken nearly simultaneously with the overpass of the NOAA-4 satellite. Observations from three radiosonde releases were averaged to provide the in situ data. These results were compared to thermal winds computed from the satellite measurements. Results of this experiment are presented and discussed. Author (GRA)

**N77-19699#** Air Force Geophysics Lab., Hanscom AFB, Mass.
**IMPROVING THE GLOBAL IONOSPHERIC PREDICTIONS OF f (o)F2 Air Force Surveys in Geophysics**
B. S. Dandekar 10 Jun. 1976 25 p refs
(AF Proj. 7663)
(AD-A030741; AFGL-TR-76-0124; AFGL-AFSG-344) Avail: NTIS HC A02/MF A01 CSCL 04/1

Using the method of Rush and Gibbs (1973), weighted means of observed values have been used to update the global prediction of f(o)F2, which are based on monthly median values derived from the Institute of Telecommunications Sciences model (1969). This procedure improved the predictions for magnetically quiet periods, for times near minimum of the solar cycle phase, and for the equinoctial months. Furthermore, a closer grid of ionosonde stations resulted in reducing the error in the f(o)F2 prediction. For the method of Rush and Gibbs (1973) to be operationally successful in global predictions of f(o)F2 however, a closer grid of ionosondes than is presently available is needed.
Author (GRA)

**N77-19700#** Bergen Univ. (Norway). Seismological Observatory.
**DETECTION SEISMOLOGY: I. PHASE REVERSAL AND TIME DELAY OF EXPLOSION-GENERATED SURFACE WAVES. II. INSTRUMENT RESPONSE OF THE KONGSBERG VLP-SYSTEM. III. UNIDENTIFIED EVENTS RECORDED BY THE KONGSBERG VLP-SYSTEM Final Scientific Report, 1 Apr. 1972 - 31 Mar. 1976**
Eivind Rygg Aug. 1976 71 p refs
(Grant AF-AFOSR-2305-72; ARPA Order 1827)
(AD-A031227; AFOSR-76-1117TR) Avail: NTIS HC A04/MF A01 CSCL 08/11

A phase shift of 180 deg. has been found between the Rayleigh wave trains of two closely located Eastern Kazakh explosions. The Rayleigh waves from one of the explosions were delayed by about 4 sec relative to the Rayleigh waves from the other explosion. The event generating the delayed Rayleigh waves excited relatively strong Love waves, but these waves were not delayed. Various causes for the anomalies have been discussed - explosion-collapse pairs- depth differences and spallation. It seems that the Love waves of the anomalous event have been generated very near the source at the time of the detonation while the Rayleigh waves have been generated by a secondary event, - collapse - or by spall closure above the explosion. GRA

**N77-19701#** Chicago Univ., Ill. Dept. of Geophysical Sciences.
**ON IMPULSE RESPONSE DATA AND THE UNIQUENESS OF THE INVERSE PROBLEM**
Victor Barcilon Sep. 1976 17 p refs
(Contract N00014-76-C-0034; NR Proj. 041-476)
(AD-A031053) Avail: NTIS HC A02/MF A01 CSCL 08/11

The problem of reconstructing the density and elastic properties of a slab of infinite horizontal extent and finite thickness set in motion by a double couple excitation is considered. It is shown that the information contained in the amplitude and frequency response associated with a single horizontal wave number is sufficient to insure the uniqueness of the solution of this inverse problem. Author (GRA)

**N77-19702#** Army Cold Regions Research and Engineering Lab., Hanover, N.H.
**PHYSICAL METHODS OF STUDYING ICE AND SNOW**
V. V. Bogorodskii Aug. 1976 250 p refs Transl. into ENGLISH from Tr. Arkticheskii i Antarkt. Nauch.-Issled. Inst. (USSR), v. 326, 1975 p 1-228
(AD-A030818; CRREL-TL-539) Avail: NTIS HC A11/MF A01 CSCL 08/12

Proceedings of a scientific symposium which was held in Leningrad on 1-5 October 1973, are published in this anthology. These arcticles by Soviet and foreign scientists reflect the results of research conducted in recent years in the following directions: (1) Electromagnetic methods for analyzing snow and ice, including active and passive radar analysis of ice and snow cover; (2) Optical methods for analyzing snow, ice, and water; and (3) Dynamic and static methods for analyzing the mechanical properties of ice and snow. GRA

**N77-19703#** San Calixto Observatory, La Paz (Bolivia).
**LONG PERIOD SEISMIC WAVES Final Report, 1 Jun. 1972 - 31 Mar. 1976**
Ramon Cabre Aug. 1976 36 p refs
(Grant AF-AFOSR-2397-72; ARPA Order 1513; ARPA Order 1827)
(AD-A031021; AFOSR-76-1096TR; pub-29) Avail: NTIS HC A03/MF A01 CSCL 08/11

A High-Gain Long-Period seismic station (ZLP) was installed in a tunnel 90m long in the Zongo Valley (16 deg 16 min 10.3 sec S, 68 deg 07 min 05.3 sec, 4397m asl), where daily barographic changes do not exceed 3 mbars, to obtain high quality data both for Federal agencies research and for Observatorio San Calixto research. A microbarograph and standard meteorological instruments were added for convenient correlations. Also short-period seismographs, with a gain of one million for one second of period, were installed. The coefficients of the formula for calculation of seismic events, and models were developed and presented for the seismic velocities as a function of depth beneath La Paz region, differing a little from one azimuth to another. As a contribution to seismicity studies, the main results of a particular earthquake are presented, together with a preliminary seismic risk map estimated according to epicenter locations and macroseismic data. GRA

**N77-19704#** Teledyne Geotechnical, Alexandria, Va. Seismic Data Analysis Center.
**ANALYSIS AND REDUCTION OF FALSE ALARMS AT LASA**
A. C. Chang, R. M. Seggelke, and R. R. Baumstark 13 May 1976 53 p refs
(Contract F08606-76-C-0004; ARPA Order 2551)
(AD-A030766; SDAC-TR-76-6) Avail: NTIS HC A04/MF A01 CSCL 08/11

The authors show that many of the 'false alarms' which required analyst intervention in the preparation of the LASA event summary were due to local or regional events. Analyses showed that these false alarms occur predominantly on weekdays

during local working hours, suggesting that the seismic events are of man-made origin. The false alarm rate decreases on weekends and holidays, and LASA reports more teleseismic events. To reduce the number of false alarms it is necessary to steer detection beams to local areas. By detecting local events on these beams and by using a higher S/N threshold in processing these signals, the number of false alarms can be effectively reduced from the original 57% to 41%. A new beam set has been developed and deployed which concentrates teleseismic beams in high seismicity areas instead of spacing them equidistantly apart. This arrangement reduced the average detection errors from 200 km to 50 km, there is also some indication of a lowered detection threshold on the order of 0.1 + or - 0.1 magnitude units. GRA

**N77-19705#** Teledyne Geotechnical, Alexandria, Va. Seismic Data Analysis Center.

**COMPARISON OF REGIONAL ATTENUATION IN EUROPE AND IN THE UNITED STATES**

Zoltan A. Der and John P. Gurski 21 Apr. 1976 58 p refs (Contract F08606-76-C-0004; ARPA Order 2551)
(AD-A030765; SDAC-TR-76-2) Avail: NTIS HC A04/MF A01

A maximum likelihood estimation procedure was applied to observations of short-period P and S waves from deep earthquakes in Europe and in the United States in order to estimate regional variations in attenuation in the two regions. The separation is much less pronounced in Europe, indicating that the variability of the observations is much less than in the United States. The results indicate that attenuation effects under stations in Europe are not as important as in the United States and therefore that station magnitude biases due to attenuation are not likely to be significant. Author (GRA)

**N77-19706#** Analytic Sciences Corp., Reading, Mass.

**SURFACE GRAVITY EFFECTS OF SUBTERRANEAN TUNNELS**

16 Jul. 1976 102 p
(Contract DAAG53-76-M-5908)
(AD-A030949; TASC-SP-988-1; ETL-0069) Avail: NTIS HC A06/MF A01 CSCL 13/2

This report determines the change of six components of the symmetric second order tensor associated with the earth's gravity field as a result of the following mass changes and conditions: (1) A tunnel 16 km long is excavated 6m below the earth's surface; (2) A vehicle traveling at a constant speed crosses the tunnel at the earth's surface; (3) The resulting tensor component changes are computed and plotted; (4) The computations are repeated for tunnel depths of 30 and 90 m; and (5) The problem may be inverted from one of subsurface mass removal to one of mass addition above the earth's surface. The results of the report determine that (1) gradiometric detection of large tunnels to a depth of 30 m is feasible, (2) reliable detection of large tunnels deeper than 30 m imposes moderately sophisticated data processing requirements, and (3) detection of tunnels deeper than 90 m is difficult. GRA

**N77-19707#** National Oceanic and Atmospheric Administration, Boulder, Colo.

**ATS6 RADIO BEACON ELECTRON CONTENT MEASUREMENTS AT BOULDER, JULY 1974 - MAY 1975**

R. B. Fritz Sep. 1976 68 p refs
(PB-261463/4; UAG-58; NOAA-76101816) Avail: NTIS MF A01; HC Avail from National Climatic Center, Federal Bldg., Asheville, N. C. 28801, Attn: Publication CSCL 04A

Routine monitoring of the plasmaspheric content was set critical requirements on transmitter and receiver stabilities. And this provided coarse and fine scales of measurements so that the cycle ambiguity in the phase measurements of both Faraday rotation and group delay could be resolved. Data recorded at 140 MHz the Boulder, Colorado ground station while ATS6 was positioned above 94 degrees West longitude is given. The satellite appeared at an azimuth of 163 degrees, elevation 42 degrees, with the projection of the ray path near the ground. All data were digitally recorded once per second. GRA

**N77-19708#** Center for the Environment and Man, Inc., Hartford, Conn.

**REGIONAL VARIATIONS OF SOLAR RADIATION WITH APPLICATION TO SOLAR ENERGY SYSTEM DESIGN Final Report**

Marshall A. Atwater and John T. Bal Jul. 1976 127 p refs (Grant NSF AER-75-14536)
(PB-259379/6; CEM-4185-550A; NSF/RA-760196) Avail: NTIS HC A07/MF A01 CSCL 04A

Numerical modeling of solar radiation data was undertaken to compute hourly values of solar radiation and other meteorological elements (temperature, dew point, wind direction, wind speed, and atmospheric radiation) at 50 stations in twelve metropolitan regions for a two-year period. Intra- and inter-regional variations of total solar radiation were analyzed. GRA

**N77-19536#** Office of Telecommunications, Boulder, Colo.

**IONOSPHERIC MODIFICATION INDUCED BY HIGH POWER HF TRANSMITTERS: POTENTIAL FOR COMMUNICATION AND PLASMA PHYSICS RESEARCH**

W. F. Utlaut *In* AGARD Artificial Modification of Propagation Media Jan. 1977 4 p refs (For primary document see N77-19530 10-42)
Avail: NTIS HC A09/MF A01

**N77-19537#** Rice Univ., Houston, Tex.

**THE HEATING EXPERIMENT AT ARECIBO**

W. E. Gordon and H. C. Carlson (Texas Univ. at Dallas, Richardson) *In* AGARD Artificial Modification of Propagation Media Jan. 1977 11 p refs (For primary document see N77-19530 10-42)
Avail: NTIS HC A09/MF A01

**N77-19539#** Max-Planck-Institut fuer Aeronomie, Lindau Uber Northeim (West Germany).

**ON THE IONOSPHERIC MODIFICATION EXPERIMENT PROJECTED AT MPI LINDAU: SCIENTIFIC OBJECTIVES**

P. Stubbe and H. Kopka *In* AGARD Artificial Modification of Propagation Media Jan. 1977 11 p refs (For primary document see N77-19530 10-42)
Avail: NTIS HC A09/MF A01

**N77-19540#** Max-Planck-Institut fuer Aeronomie, Lindau Uber Northeim (West Germany).

**ON THE IONOSPHERIC MODIFICATION EXPERIMENT PROJECTED AT MPI LINDAU: PRACTICAL REALIZATION**

H. Kopka, P. Stubbe, and R. Zwick *In* AGARD Artificial Modification of Propagation Media Jan. 1977 7 p refs (For primary document see N77-19530 10-42)
Avail: NTIS HC A09/MF A01

**N77-19543#** Max-Planck-Institut fuer Extraterrestrische Physik, Garching (West Germany).

**MODIFICATION OF IONIZED MEDIA BY CHEMICAL SUBSTANCES: A REVIEW OF PHYSICAL PROCESSES**

G. Haerendel *In* AGARD Artificial Modification of Propagation Media Jan. 1977 15 p refs (For primary document see N77-19530 10-42)
Avail: NTIS HC A09/MF A01

**N77-19544#** Boston Univ., Mass. Dept. of Astronomy.

**SPATIAL-TEMPORAL DEVELOPMENT OF MOLECULAR RELEASES CAPABLE OF CREATING LARGE-SCALE F-REGION HOLES**

Michael Mendillo and Jeffrey M. Forbes (Boston College) *In* AGARD Artificial Modification of Propagation Media Jan. 1977 8 p refs (For primary document see N77-19530 10-42)
(Contract F19628-75-C-0044)
Avail: NTIS HC A09/MF A01

**N77-19545*#** Stanford Univ., Calif. Radioscience Lab.

**CHEMICAL DEPLETION OF THE IONOSPHERE**

P. A. Bernhardt, A. V. DaRosa, and C. G. Park *In* AGARD Artificial Modification of Propagation Media Jan. 1977 16 p refs Sponsored in part by NSF (For primary document see N77-19530 10-42)
(Contract NAS8-31769; Grant NGR-05-020-001)
Avail: NTIS HC A09/MF A01

**N77-19546#** Leicester Univ. (England).
**SOME EFFECTS OF A HIGH ALTITUDE BARIUM RELEASE ON THE PROPAGATION CHARACTERISTICS OF HF RADIOWAVES**
T. B. Jones and C. T. Spracklen *In* AGARD Artificial Modification of Propagation Media Jan. 1977 7 p refs Sponsored by the Procurement Executive Ministry of Defence (For primary document see N77-19530 10-42)
Avail: NTIS HC A09/MF A01

**N77-19547#** Atomic Weapons Research Establishment, Aldermaston (England).
**MODIFICATION OF THE IONOSPHERE BY BARIUM ION CLOUDS**
A. J. Baxter *In* AGARD Artificial Modification of Propagation Media Jan. 1977 10 p refs (For primary document see N77-19530 10-42)
Avail: NTIS HC A09/MF A01

# 47 METEOROLOGY AND CLIMATOLOGY

Includes weather forecasting and modification.

**N77-19709*** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**SATELLITE-DERIVED GLOBAL OCEANIC RAINFALL ATLAS (1973 AND 1974)**
M. S. V. Rao, W. V. Abbott, III, and J. S. Theon 1976 336 p refs Original contains color illustrations
(NASA-SP-410; LC-76-600054) Avail: SOD HC as C/N NAS1.21:410 CSCL 04B

Based on the relationship between satellite-borne electrically scanning microwave radiometer brightness temperatures and rain rates over oceans, quantitative maps of rainfall were obtained from Nimbus-5 microwave data. Weekly, monthly, seasonally, and annually averaged maps were generated from December 1972 through February 1975. From these maps, the patterns of rainfall in the Pacific, Atlantic, and Indian Oceans were analyzed. It was shown that the data permit the monitoring of features such as the movement of the Intertropical Convergence Zone and the advance of the Indian Monsoon. An interesting rainfall pattern in the Pacific, associated with the El Nino phenomenon, was interpreted in terms of a local variation of the Hadley cell circulation. The variations in oceanic rainfall and in latent heat release (which was also computed) should provide useful inputs to numerical models and to studies of planetary energy and water budgets. Author

**N77-19710*#** Techno-Sciences, Inc., Annapolis, Md.
**REDUCTION AND ANALYSIS OF DATA COLLECTED DURING THE ELECTROMAGNETIC TORNADO EXPERIMENT Final Report, Jul. 1975 - Jun. 1976**
L. D. Davisson Jul. 1976 91 p
(Contract NAS5-22489)
(NASA-CR-152455; TSI-76112) Avail: NTIS HC A05/MF A01 CSCL 04B

Techniques for data processing and analysis are described to support tornado detection by analysis of radio frequency interference in various frequency bands, and sea state determination from short pulse radar measurements. Activities include: strip chart recording of tornado data; the development and implementation of computer programs for digitalization and analysis of the data; data reduction techniques for short pulse radar data, and the simulation of radar returns from the sea surface by computer models. Author

**N77-19711*#** Techno-Sciences, Inc., Annapolis, Md.
**DAILY WEATHER DIRECT READOUT MICROPROCESSOR STUDY Final Report, Jul. 1975 - Jun. 1976**
L. D. Davisson and J. B. Davisson Jul. 1976 18 p refs
(Contract NAS5-22476)
(NASA-CR-152456; TSI-76613) Avail: NTIS HC A02/MF A01

The work completed included a study of the requirements and hardware and software implementation techniques for NIMBUS ESMR and TWERLE direct readout applications using microprocessors. Many microprocessors were studied for this application. Because of the available Interdata development capabilities, it was concluded that future implementations be on an Interdata microprocessor which was found adequate for the task. Author

**N77-19712#** National Environmental Satellite Service, Washington, D.C.
**ENVIRONMENTAL SATELLITE IMAGERY Key to Meteorological Records Documentation**
Environmental Data Service Aug. 1976 36 p refs
(Rept-5.4) Avail: NTIS HC A03/MF A01

Daily mosaics are presented for the Northern and Southern Hemispheres. These were prepared from data swaths by a scanning radiometer on NOAA satellites. Author

**N77-19713*#** Texas A&M Univ., College Station. Center for Applied Geosciences.
**THE MOISTURE BUDGET IN RELATION TO CONVECTION**
Robert W. Scott and James R. Scoggins Mar. 1977 97 p refs
(Contract NAS8-31773)
(NASA-CR-2817; M-216) Avail: NTIS HC A05/MF A01 CSCL 04B

An evaluation of the moisture budget in the environment of convective storms is presented by using the unique 3- to 6-h rawinsonde data. Net horizontal and vertical boundary fluxes accounted for most of the large amounts of moisture which were concentrated into convective regions associated with two squall lines that moved through the area during the experiment. The largest values of moisture accumulations were located slightly downwind of the most intense convective activity. Relationships between computed moisture quantities of the moisture budget and radar-observed convection improved when lagging the radar data by 3 h. The residual of moisture which represents all sources and sinks of moisture in the budget equation was largely accounted for by measurements of precipitation. Author

**N77-19714*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**CORRELATION OF TOTAL, DIFFUSE, AND DIRECT SOLAR RADIATION**
Edgar H. Buyco (Purdue Univ., Hammond, Ind.) and David Namkoong Washington Mar. 1977 25 p refs
(NASA-TM-X-3422; E-8867) Avail: NTIS HC A02/MF A01 CSCL 04B

Present requirements for realistic solar energy system evaluations necessitate a comprehensive body of solar-radition data. The data should include both diffuse and direct solar radiation as well as their total on an hourly (or shorter) basis. In general, however, only the total solar radiation values were recorded. This report presents a correlation that relates the diffuse component of an hourly total solar radiation value to the total radiation ratio of the maximum value attainable. The data used were taken at the Blue Hill Obseivatory in Milton, Massachusetts, for the period 1952. The relation - in the form of the data plots - can be used in situations in which only the hourly total radiation data are available but the diffuse component is desired. Author

**N77-19715*#** Science Applications, Inc., Huntsville, Ala.
**DETERMINATION OF CONSTANT-VOLUME BALLOON CAPABILITIES FOR AERONAUTICAL RESEARCH**
Frank B. Tatom and Richard L. King Washington NASA Mar. 1977 186 p refs
(Contract NAS8-31173)
(NASA-CR-2805; M-208) Avail: NTIS HC A09/MF A01 CSCL 04B

The proper application of constant-volume balloons (CVB) for measurement of atmospheric phenomena was determined. And with the proper interpretation of the resulting data. A literature survey covering 176 references is included. the governing equations describing the three-dimensional motion of a CVB immersed in a flow field are developed. The flowfield model is periodic, three-dimensional, and nonhomogeneous, with mean translational motion. The balloon motion and flow field

equations are cast into dimensionless form for greater generality, and certain significant dimensionless groups are identified. An alternate treatment of the balloon motion, based on first-order perturbation analysis, is also presented. A description of the digital computer program, BALLOON, used for numerically integrating the governing equations is provided. Author

**N77-19716*#** Colorado State Univ., Fort Collins.
**WIND-TUNNEL MEASUREMENTS IN THE WAKES OF STRUCTURES**
H. G. C. Woo, J. A. Peterka, and J. E. Cermak Washington NASA Mar. 1977 243 p refs
(Contract NAS8-29583)
(NASA-CR-2806; M-210) Avail: NTIS HC A11/MF A01 CSCL 04B

Detailed measurements of longitudinal mean velocity, turbulence intensity, space correlations, and spectra made in the wake of two rectangular scaled models in simulated atmospheric boundary-layer winds are presented. The model buildings were 1:50 scale models of two trailers. Results of a flow visualization study of the wake geometry are analyzed with some singular point theorems. Two hypothetical flow patterns of the detailed wake geometry are proposed. Some preliminary studies of the vortex wake, effects of the model size, model aspect ratios, and boundary layer characteristics on the decay rate and extent of the wake are also presented and discussed. Author

**N77-19717#** California Univ., Livermore. Lawrence Livermore Lab.
**ENVIRONMENTAL TESTS OF THE METEOROLOGICAL DATA ACQUISITION SYSTEM'S REMOTE STATION**
C. C. Aaron, Jr. 10 May 1976 23 p
(Contract W-7405-eng-48)
(UCID-17121) Avail: NTIS HC A02/MF A01

The Meteorological Data Acquisition (MEDA) remote station hardware was subjected to temperature, vibration, and road tests. The prototype system passed these tests. ERA

**N77-19718#** Battelle Pacific Northwest Labs., Richland, Wash.
**ANALYTICAL DERIVATION OF A STABLE DISTRIBUTION OF MARINE AEROSOLS**
Ronald L. Drake 1976 33 p refs Presented at 2nd Conf. on Ocean-Atmospheric Interactions, Seattle, 29 Mar. - 2 Apr. 1976; sponsored by American Meteorological Society
(Contract E(45-1)-1830)
(BNWL-SA-5732; Conf-760335-2) Avail: NTIS HC A03/MF A01

The derived distribution possesses many of the characteristics that have been observed by field investigators. The mathematical system that was used describes the time evolution of an aerosol distribution in a nonhomogeneous medium. In addition, the processes producing the changes in the aerosol spectrum are a volumetric source and sink distribution, condensational growth mechanism, a coagulation mechanism, a vertical velocity field, gravitational settling, and vertical diffusion. ERA

**N77-19719#** Du Pont de Nemours (E. I.) and Co., Aiken, S.C. Savannah River Lab.
**PDP-11 BASED SYSTEM FOR METEOROLOGICAL DATA ACQUISITION AND EMERGENCY RESPONSE**
C. D. Kern, R. A. Mueller, and J. M. Sandler 1976 6 p Presented at the 1976 Spring DECUS Symp., Atlanta, 25-28 May 1976
(Contract AT(07-2)-1)
(DP-MS-76-14; Conf-760559-2) Avail: NTIS HC A02/MF A01

The Weather Information and Display (WIND) system, a PDP-11/40 computer was installed at the Savannah River Laboratory. The system assimilates and uses large volumes of meteorological data in research programs on atmospheric transport and dispersion; it also facilitates the assessment of accidental releases of pollutants to the atmosphere. The computer systematically acquires data from meteorological sensors located on a number of towers in and around the Savannah River Plant site. These data are checked for accuracy and are used to prepare turbulence statistics and graphical displays of wind fields on a Tektronix scope. The results provide input to a number of meteorological research activities. ERA

**N77-19720#** Wyoming Univ., Laramie.
**THE 1975 OPERATIONAL REPORT FOR METROMEX**
Nov. 1976 49 p refs
(Contract E(11-1)-1199)
(TID-27098) Avail: NTIS HC A03/MF A01

Project METROMEX is a federation of research groups from several different institutions, applying their skills and facilities in a complementary and coordinated fashion to study inadvertent weather modification in the St. Louis Metropolitan area. The project has been supported by the State of Illinois and several Federal agencies. The calendar of operations during the 1975 summer season is given along with a brief outline of project background. Not covered are several theoretical, laboratory and numerical modeling efforts which are METROMEX related but not directly involved in field observations. ERA

**N77-19721#** Freie Univ., Berlin (West Germany). Inst. fuer Meteorologie.
**METEOROLOGICAL DATA. VOLUME 145, NO. 4: THE EUROPEAN CLIMATOLOGY 1974. WEATHER SATELLITE DATA FROM THE BERLIN RECEIVING STATION, PART 4 Quarterly Report [METEOROLOGISCHE ABHANDLUNGEN. BAND 145/HEFT 4: DAS EUROPAEISCHE WETTERBILD 1974. WETTERSATELLITEN-DATEN AUS DEM BERLINER EMPFANGSBEREICH. TEIL 4, 4- VIERTELSJAHR]**
Verlag von Dietrisch Reimer 1974 216 p refs In GERMAN
(QR-4) Avail: NTIS HC A10/MF A01

Berlin ground station equipment for receiving S band signals from the NOAA satellites is described and daily pictures are presented covering the last quarter of 1974 of the European weather situation based on automatic picture transmission from ESSA 8 satellite. Picture taken by the scanning radiometer of NOAA 3 and NOAA 4 satellites are also included. ESA

**N77-19722#** Denver Research Inst., Colo. Cloud Physics Lab.
**FIELD MEASUREMENTS WITH A CLOUD CONDENSATION NUCLEUS SPECTROMETER IN MARINE FOG Annual Progress Report**
N. Fukuta and V. K. Saxena Dec. 1975 31 p refs
(Contract N00019-75-C-0310; DRI Proj. 5215)
(AD-A030859) Avail: NTIS HC A03/MF A01 CSCL 04/1

During the last one-year reporting period, a field version of this laboratory's Cloud Condensation Nucleus (CCN) Spectrometer capable on continuously monitoring and displaying in real-time the activation spectrum of fog and cloud nuclei--was fabricated and field-tested. The tests proved it to be a dependable field instrument. In July, 1975, the CCN Spectrometer was installed aboard U. S. Naval Ship Hayes for measuring the characteristics of aerosols that participated in marine fog formation. The spectrum measurement were made during a three-week-long cruise aboard the ship off the coasts of Nova Scotia and Newfoundland. Some two thousand spectra were measured while approaching the fog, in the fog, and getting out of the fog. A variety of fog conditions were encountered in the field. Field measurements demonstrate that the fog nuclei spectrum in the supersaturation range 0.15-1.2% undergoes a marked change at the fog boundaries. GRA

**N77-19723#** National Hurricane and Experimental Meteorology Lab., Coral Gables, Fla.
**CLOUD INTERACTION AND THE FORMATION OF THE 15 JUNE 1973 TORNADO IN THE FACE MESONETWORK**
Ronald L. Holle and Michael W. Maier Oct. 1976 62 p refs
(PB-261421/2; NOAA-TM-ERL-WMPO-33; NOAA-76100701) Avail: NTIS HC A04/MF A01 CSCL 04B

The 15 June 1973 tornado that occurred within the FACE surface mesonetwork was measured from a series of 15 photographs taken in the vicinity. Very weak synoptic scale flow was evident at all levels to 100 mb over south Florida. A weak ridge at low levels and a slight trough at 500 mb were the only significant features in the area. Normal stability for summer 1973 was found at Miami, but shear was the weakest of the summer, equalled only on 16 June. Rainfall over Florida was related to heating, coastal, and lakeshore effects of the peninsula and not to external factors. Two clouds with tops of 15.6 km reached their peak intensity 25 km east and west of the tornado 50 minutes before its start. GRA

**N77-19724#** National Oceanic and Atmospheric Administration, Las Vegas, Nev. Air Resources Lab.
**SUMMERTIME RADAR ECHO DISTRIBUTIONS OF MOIST CONVECTION OVER SOUTHERN NEVADA AND ADJACENT AREAS FOR 1971 AND 1972**
Darryl Randerson Aug. 1976 42 p refs
(PB-261456/8; NOAA-TM-ERL-ARL-58; NOAA-76101204)
Avail: NTIS HC A03/MF A01 CSCL 04B

Two warm seasons of hourly radar echo activity are used to develop a preliminary climatological picture of the spatial and temporal distributions of moist convection over southern Nevada and adjacent areas. The echo distributions are adjusted for the probability of radar detection of surface precipitation. Results of the analysis quantitatively portray the enhancement of echo activity by mountainous terrain. During daylight hours, the high mountainous areas are shown to receive approximately 2 to 3 times more echo activity than the desert valleys and roughly 5 times more activity between midnight and 0700 LST. Spatial variations in echo activity are compared with different categories of K-index and precipitable water. GRA

**N77-19725#** National Oceanic and Atmospheric Administration, Silver Spring, Md. Air Resources Lab.
**AN EVALUATION OF PRECIPITATION pH DATA FROM THE WASHINGTON, D. C. AREA COLLECTED DURING 1975**
John M. Miller, Gerald F. Cotton, Donald H. Pack, J. Murray Mitchell, and Milton E. Smith Aug. 1976 28 p refs
(PB-261457/6; NOAA-76101203) Avail: NTIS HC A03/MF A01 CSCL 04B

An experimental volunteer program to collect precipitation for determination of pH (and pH only) was begun in April, 1974, to gain practical experience in collection and analysis and some data on the acidity of precipitation. Rain or snow was collected in 4 inch diameter plastic rain gages by volunteers, transferred to washed plastic bottles, tightly capped. The pH measurements were made with an electrode and an pH meter, and pH determinations were usually made within 12-48 hours of collection. The pH values compare well with pH values measured in the Northeastern U.S. GRA

**N77-19726#** National Oceanic and Atmospheric Administration, Silver Spring, Md. Air Resources Labs.
**BOUNDARY-LAYER TRAJECTORY ESTIMATES COMPARED WITH CONSTANT-VOLUME BALLOON TRAJECTORIES IN THE GREAT PLAINS**
Walter H. Hoecker Aug. 1976 36 p refs
(PB-261419/6; NOAA-TM-ERL-ARL-59; NOAA-76101301)
Avail: NTIS HC A03/MF A01 CSCL 04B

The reconstruction of boundary layer air trajectories traced out by constant volume balloons (tetroons) flown in the Great Plains is described. The tetroons, flown at 300 m above the ground, were deployed in September and October of 1971 during periods of strong southerly, weak northerly and moderate to strong westerly winds. Use was made of geostrophic, layer average and adjusted surface winds in the reconstructions. The accuracy of the reconstructed, or estimated, trajectory was based on the distance the estimated trajectory missed the tetroon recovery site at its closest approach. Trajectories were computed for approximately the same length of time that the tetroons were aloft. GRA

**N77-19727#** National Weather Service, Fort Worth, Tex.
**AN AID TO AGRICULTURAL DEW FORECASTING**
Nicholas P. Cimino (Natl. Weather Service Forecast Office, Oklahoma City) Sep. 1976 14 p refs
(PB-261420/4; NOAA-TM-NWS-SR-87; NOAA-76101303)
Avail: NTIS HC A02/MF A01 CSCL 04B

Equations which forecast dew intensity, starting time and drying time are presented. Verification of the dew intensity equation on independent data does indicate reasonable skill for both the area of development and a separate area. The present system does not supply feedback of verifying observations which is prerequisite to improving the forecasting of dew. GRA

**N77-19531#** Schule fuer Wehrgeophysik, Fuerstenfeldbruck (West Germany).
**NON-IONISED PROPAGATION MEDIA WITH ARTIFICIALLY MODIFIED PRECIPITATION CHARACTERISTICS**
E. Kleinjung *In* AGARD Artificial Modification of Propagation Media Jan. 1977 10 p refs (For primary document see N77-19530 10-42)
Avail: NTIS HC A09/MF A01

**N77-19534#** Mainz Univ. (West Germany). Inst. fuer Meteorologie.
**DISCUSSION OF ARTIFICIAL FOG MODIFICATION**
Gottfried Haenel *In* AGARD Artificial Modification of Propagation Media Jan. 1977 3 p refs (For primary document see N77-19530 10-42)
Avail: NTIS HC A09/MF A01

**N77-19535#** Clermont-Ferrand Univ. (France).
**ARTIFICIAL MODIFICATION OF THE AIR MICROSTRUCTURE INSIDE CLOUDY OR SIMPLY MOIST STRATIFIED LAYERS**
R. Serpolay, M. Andro (Univ. de Bretagne Occidentale, I.U.T. de Lorient, France), and S. Godard *In* AGARD Artificial Modification of Propagation Media Jan. 1977 13 p refs (For primary document see N77-19530 10-42)
Avail: NTIS HC A09/MF A01

## 48 OCEANOGRAPHY

Includes biological, dynamic and physical oceanography; and marine resources.

**N77-19728#** Lamont-Doherty Geological Observatory, Palisades, N. Y.
**TRANSPORT AND TRANSFER RATES IN THE WATERS OF THE CONTINENTAL SHELF Annual Report**
P. E. Biscaye, W. S. Broecker, H. W. Feely, and R. D. Gerard Apr. 1976 138 p refs
(Contract E(11-1)-2185)
(COO-2185-9) Avail: NTIS HC A07/MF A01

The rates of mixing within coastal waters of the New York Bight and across the continental slope are considered along with the exchange of water masses and species transported within them between shelf and Atlantic Ocean waters. The chemical, physical, and biological processes which control the origin, dispersal, and fate of particulate matter and trace metals are emphasized. The impact of energy related pollutants on the continental shelf is modeled. ERA

## 51 LIFE SCIENCES (GENERAL)

Includes genetics.

**N77-19729*#** Alcorn State Univ., Lorman, Miss. Dept. of Biological Sciences.
**BIO-GAS PRODUCTION FROM ALLIGATOR WEEDS Semiannual Report**
Abdul Latif 1 Jun. 1976 11 p
(Grant NsG-8036)
(NASA-CR-149809) Avail: NTIS HC A02/MF A01 CSCL 06C

Laboratory experiments were conducted to study the effect of temperature, sample preparation, reducing agents, light intensity and pH of the media, on bio-gas and methane production from the microbial anaerobic decomposition of alligator weeds (Alternanthera philoxeroides. Efforts were also made for the isolation and characterization of the methanogenic bacteria. Author

**N77-19730#** Florida Univ., Gainesville. Water Resources Research Center.
**INTERRELATIONSHIPS BETWEEN CERTAIN MICROORGANISMS AND SOME ASPECTS OF SEDIMENT-WATER NUTRIENT EXCHANGE IN TWO BAYOU ESTUARIES, PHASE 1 AND 2**
Gerald A. Moshiri (West Florida Univ.) 12 Jul. 1976 50 p refs

(Contracts DI-14-31-0001-5065)
(PB-259538/7; WRRC-Pub-37; W77-00674) Avail: NTIS HC A03/MF A01 CSCL 13B

Over a two-year period, certain aspects of nutrient exchange and regeneration were studied as related to major physical, chemical, and microbial parameters in two bayou estuaries. Sediment to water phosphate PO4(-3) exchange was affected by dissolved oxygen concentrations in both systems, but Eh effects of oxygen depletion on PO4(-3) exchange kinetics differed in the two bayous. Sediment Eh profiles followed a temporal pattern perhaps related to the bacterial activity. Glucose concentrations and uptake were monitored as related to possible sources and utilizers respectively. GRA

**N77-19731#** Advisory Group for Aerospace Research and Development, Paris (France).

**RECENT ADVANCES IN SPACE MEDICINE**

J. Colin, ed. Jan. 1977 113 p refs In ENGLISH; partly in FRENCH Conf. Proc of the Aerospace Medical Panel Specialists' Meeting, Athens, 20-24 Sep. 1976
(AGARD-CP-203; ISBN-92-835-0186-1) Avail: NTIS HC A06/MF A01

Some of the topics discussed are: the effect of free fall on the vestibular organ and of its post flight readaptation as part of the shuttle program; successful transfer of adaptation aquired in a slow rotation room to motion environments in Navy flight training; environmental investigations on motion sickness susceptibility; and space mission simulation. The significance of physical fitness in selection and training of spacelab crews; and the psychometric characteristics of astronauts are also reviewed. For individual titles, see N77-19732 through N77-19744.

**N77-19732#** Milan Univ. (Italy).

**INVESTIGATION OF THE EFFECT OF FREE FALL ON THE VESTIBULAR ORGAN AND OF ITS POST-FLIGHT READAPTATION AS PART OF THE SHUTTLE PROGRAM: A CONTRIBUTION TO BASIC VESTIBULAR PHYSIOLOGY AND TO THE PROBLEM OF SPACE SICKNESS** c52

Torquato Gualtierotti *In* AGARD Recent Advances in Space Medicine Jan. 1977 7 p refs (For primary document see N77-19731 10-51)
Avail: NTIS HC A06/MF A01

Basic vestibular physiology and the problem of space sickness was reviewed. A space experiment monitoring the single vestibular statoreceptors output indicated important reversible and unreversible changes. The significance of such changes is discussed. Author

**N77-19733*#** Naval Aerospace Medical Research Lab., Pensacola, Fla.

**SUCCESSFUL TRANSFER OF ADAPTATION ENVIRONMENTS IN NAVY FLIGHT TRAINING** c54

D. B. Cramer, A. Graybiel, and W. J. Oosterveld *In* AGARD Recent Advances in Space Medicine Jan. 1977 5 p refs Sponsored by NASA (For primary document see N77-19731 10-51)
Avail: NTIS HC A06/MF A01

Two flight students, grounded for the reason they were highly susceptible to motion sickness, completed their training after gradually adapting 10 rpm, achieved by executing head movements during small stepwise increases in angular velocity. Subject 1 executed a total of about 77,000 head movements within a period of five months and Subject 2 executed about 108,000 head movements within a period of 42 days. The transfer of the adaptation acquired in the laboratory to most motion environments aloft was good; the notable exception involved weightless maneuvers in the case of Subject 1. Both were on flight status when contacted recently. The current motion sickness susceptibility in Subject 1 in the fall of 1975 was assessed. He reached a (mild) motion sickness endpoint, in the rotating room, at 17 rpm; the average endpoint is 7 to 8 rpm. Some practical and theoretical implications are discussed. Author

**N77-19734#** Air Force Inst. of Aviation Medicine, Fuerstenfeldbruck (West Germany).

**EXPERIMENTAL INVESTIGATIONS ON MOTION SICKNESS SUSCEPTIBILITY** c52

W. Hoffelt *In* AGARD Recent Advances in Space Medicine Jan. 1977 5 p refs (For primary document see N77-19731 10-51)
Avail: NTIS HC A06/MF A01

The sensory conflict theory formulated by REASON was experimentally examined with psychological and sensory-physiological methods in two groups differing in their resistence towards coriolis accelerations. In all tests applied both groups showed consistent behavioral differences which may be interpreted in the sense of the conflict theory. Author

**N77-19735#** Air Force Inst. of Aviation Medicine, Fuerstenfeldbruck (West Germany).

**SPACE MISSION TRAINING: A NECESSARY ELEMENT IN PLANNING AND TRAINING FOR SHUTTLE SPACELAB MISSIONS** c54

Eduard C. Burchard *In* AGARD Recent Advances in Space Medicine Jan. 1977 13 p (For primary document see N77-19731 10-51)
Avail: NTIS HC A06/MF A01

In an attempt during the last 2 years to evaluate space mission simulations, two shuttle spacelab simulations were performed at the NASA Lyndon B. Johnson Space Center. The first spacelab mission simulation provided valuable insights into the many Shuttle Spacelab Operations which were not necessarily payload dependent. Two crewmen, free of Orbiter duties, acted as mission specialist and payload specialists to operate 12 typical life sciences experiments on one shift schedule. The second spacelab mission simultion involved one mission specialist and two payload specialists in a 7-day multidiscipline simulation which included 20 life sciences experiments and one cosmic ray laboratory experiment. The use of space mission simulations in preparation for Shuttle Spacelab Missions is discussed. Author

**N77-19736#** Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Bad Godesberg (West Germany). Inst. fuer Flugmedizin.

**NEUTRAL BUOYANCY: ONE POSSIBLE TOOL FOR MAN'S TRAINING IN A SIMULATED ZERO-G ENVIRONMENT** c54

Heinz Oser *In* AGARD Recent Advances in Space Medicine Jan. 1977 5 p refs (For primary document see N77-19731 10-51)
Avail: NTIS HC A06/MF A01

In order to get the payload specialists well prepared for performing their tasks under space conditions in a resonable time, the water immersion technique for simulating certain aspects of zero and partial gravity condition is amongst others one possible tool. The water immersion technique was used mainly for three purposes: (1) studying physiological responses to weightlessness, (2) evaluating human performance under quasi weightless conditions, and (3) testing equipment, facilities and simulation techniques. Author

**N77-19737#** Erno Raumfahrttechnik G.m.b.H., Bremen (West Germany).

**HUMAN ENGINEERING: CREW SYSTEMS TOOL FOR SPACELAB DESIGN** c54

Udo G. Munkelt (McDonnell-Douglas Corp., St. Louis) and Harold S. Jencks (McDonnell-Douglas Corp., St. Louis) *In* AGARD Recent Advances in Space Medicine Jan. 1977 9 p refs (For primary document see N77-19731 10-51)
Avail: NTIS HC A06

The space shuttle spacelab system is described with emphasis on crew accommodation/utilization. The artificially supplied internal environment is discussed which provides for the well being of the crew in the hostile surroundings of space including atmosphere, temperature, lighting and noise. The interior arrangement of spacelab showing architectural considerations which essentially provide a one - G oriented concept in respect to work stations, display control consoles, floor, ceiling, etc., minimizing disorientation and faciliting ground operations is explained. The restraint systems are cited which enable the crewman not only to overcome the negative aspects of working in zero - G, but also to take advantage of the positive aspects. Several photos and sketches are provided showing full scale Mockups and neutral buoyancy test fixtures which support the human engineering considerations in Spacelab design/development. Author

**N77-19738*#** Royal Air Force Inst. of Aviation Medicine, Farnborough (England).
**THE EFFECTS OF PROLONGED SPACEFLIGHT ON THE REGIONAL DISTRIBUTION OF FLUID, MUSCLE AND FAT: BIOSTEREOMETRIC RESULTS FROM SKYLAB c52**
M. W. Whittle, R. E. Herron (Texas Inst. for Rehabilitation and Res., Houston), J. R. Cuzzi (Texas Inst. for Rehabilitation and Res., Houston), and C. W. Keys (Technology Inc., Houston) *In* AGARD Recent Advances in Space Medicine Jan. 1977 5 p refs (For primary document see N77-19731 10-51)
(Contract NAS9-11604)
Avail: NTIS HC A06/MF A01

Biostereometric analysis of body form was performed several times preflight and postflight on the astronauts of all three skylab flights. The analysis was made by deriving the three-dimensional coordinates of numerous points on the body surface from stereoscopic pairs of photographs of the subject, using a stereoplotter. The volume of segments of the body, and of the body as a whole, was calculated by integration of cross sectional areas derived from the coordinate data. All nine astronauts demonstrated regional changes in volume distribution which could be related to changes in total body water, muscle mass, and fat deposits. The change in water resulted from a redistribution of fluid in response to zero gravity. Changes in muscle mass resulted from an alternation in patterns of muscular activity in the absence of gravity, and changes in fat resulted from discrepancies between the individual's caloric needs and his food consumption. Author

**N77-19739#** Air Force Inst. of Aviation Medicine, Fuerstenfeldbruck (West Germany).
**OPHTHALMOLOGICAL REQUIREMENTS FOR SPACELAB ASTRONAUT-SCIENTISTS c52**
F. J. Dauman *In* AGARD Recent Advances in Space Medicine Jan. 1977 6 p refs (For primary document see N77-19731 10-51)
Avail: NTIS HC A06/MF A01

Ophthalmological requirements for visual acuity, field of vision, binocular vision, accommodation, color vision, and equilibrium of eye muscles are presented from an occupational medical point of view. Correction of visual deficiencies by means of glasses and contact lenses is discussed. The necessity of full visual field, binocular vision, dark adaptation and color vision is stressed. Next, anomalies and diseases compatible with the stresses of a payload-specialist and those causing rejection are covered. Author

**N77-19740#** Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Bad Godesberg (West Germany). Inst. fuer Flugmedizin.
**ATHLETIC ENDURANCE TRAINING: ADVANTAGE FOR SPACE FLIGHTS? THE SIGNIFICANCE OF PHYSICAL FITNESS FOR SELECTION AND TRAINING OF SPACELAB CREWS c52**
K. E. Klein, H. M. Wegmann, and P. Kuklinski *In* AGARD Recent Advances in Space Medicine Jan. 1977 13 p refs (For primary document see N77-19731 10-51)
Avail: NTIS HC A06/MF A01

The morphological and functional changes obtained with an athletic endurance training are rather specific, and not at all, of general advanatage for the tolerance to space stresses. In particular during gravitational loads they allow a higher shift of fluid into the lower extremities with the possible consequence of a reduced tolerance. This response obviously, is accentuated through immersion and weightlessness; also, the aerobic work capacity is more impaired. Author

**N77-19741#** School of Aerospace Medicine, Brooks AFB, Tex.
**PSYCHOMETRIC CHARACTERISTICS OF ASTRONAUTS c53**
Bryce O. Hartman and Richard C. McNee *In* AGARD Recent Advances in Space Medicine Jan. 1977 9 p refs (For primary document see N77-19731 10-51)
Avail: NTIS HC A06/MF A01

Detailed information on the role of psychological testing in the selection process for NASA astronauts is reported. Because of the current activity in the European space agency, where there is a requirement for astronaut selection, psychometric procedures and data are of renewed scientific interest. An overview of the psychometric process and extensive statistical analyses are reported. Author

**N77-19742#** Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Hamburg (West Germany). Inst. fuer Flugmedizin.
**PSYCHOLOGICAL SELECTION OF ASTRONAUT-SCIENTISTS (PAYLOAD SPECIALISTS) c53**
Klaus-Martin Goeters *In* AGARD Recent Advances in Space Medicine Jan. 1977 5 p refs (For primary document see N77-19731 10-51)
Avail: NTIS HC A06/MF A01

Psychological testing of spacelab-payload specialists is mandatory. Astronaut-scientists characteristics were discussed: (1) High basic technical comprehension and practical skills, (2) high motivation, (3) adequate group behavior, and (4) emotional maturity and stress resistence. The significance of these psychological factors for working in confinement are demonstrated by experimental results. Author

**N77-19743#** Royal Air Force Inst. of Aviation Medicine, Farnborough (England).
**EXPERIMENTAL BASIS FOR THE USE OF HYPNOTICS BY AEROSPACE CREWS c53**
A. N. Nicholson, R. G. Borland, Coral H. Clarke, and Barbara M. Stone *In* AGARD Recent Advances in Space Medicine Jan. 1977 11 p refs (For primary document see N77-19731 10-51)
Avail: NTIS HC A06/MF A01

The work which was carried out at the Royal Air Force Institute of Aviation Medicine on the immediate and residual effects of hypnotics on performance, the effectiveness of hypnotics, and the problems associated with the use of hypnotics at unusual times of the day is reviewed. Author

**N77-19744*#** National Aeronautics and Space Administration, Washington, D.C.
**SPACE AGE HEATLH CARE DELIVERY c52**
Walter L. Jones *In* AGARD Recent Advances in Space Medicine Jan. 1977 9 p refs (For primary document see N77-19731 10-51)
Avail: NTIS HC A06/MF A01 CSCL 06E

Space age health care delivery is being delivered to both NASA astronauts and employees with primary emphasis on preventive medicine. The program relies heavily on comprehensive health physical exams, health education, screening programs and physical fitness programs. Medical data from the program is stored in a computer bank so epidemiological significance can be established and better procedures can be obtained. Besides health care delivery to the NASA population, NASA is working with HEW on a telemedicine project STARPAHC, applying space technology to provide health care delivery to remotely located populations. Author

## 52 AEROSPACE MEDICINE

Includes physiological factors, biological effects of radiation; and weightlessness.

**N77-19745*+** National Aeronautics and Space Administration, Washington, D.C.
**AEROSPACE MEDICINE AND BIOLOGY: A CONTINUING BIBLIOGRAPHY WITH INDEXES, SUPPLEMENT 164**
Feb. 1977 92 p
(NASA-SP-7011(164)) Avail: NTIS HC A05 CSCL 06E

This bibliography lists 275 reports, articles, and other documents introduced into the NASA scientific and technical information system in January 1977. Author

**N77-19746*#** Methodist Hospital, Houston, Tex.
**AUTOMATED ELECTROENCEPHALOGRAPHY SYSTEM AND ELECTROENCEPHALOGRAPHIC CORRELATES OF SPACE MOTION SICKNESS, PART 3 Final Report**
James D. Frost, Jr. 15 Feb. 1977 179 p refs
(Contract NAS9-13870)
(NASA-CR-151210) Avail: NTIS HC A09/MF A01 CSCL 06P

Computer quantification methods were used to analyze the Skylab electroencephalographic data obtained during the course of the M133 series of experiments. This undertaking was prompted by initial observations made during visual analysis of the tape-recorded sleep records where there appeared to be an increase of the alpha-rhythm frequency during some inflight recording sessions, as compared to preflight baseline observations. A number of potential etiological factors are identified and their various possible influences discussed. The presence of the zero-g state is thought to be an important factor, possibly influencing EEG through alteration of vestibular function and/or by producing fluid shifts secondary to loss of hydrostatic pressure. Author

**N77-19747*#** Technology, Inc., Houston, Tex. Life Sciences Div.
**SYSTOLIC TIME INTERVAL DATA ACQUISITION SYSTEM. SPECIALIZED CARDIOVASCULAR STUDIES**
Joseph T. Baker 3 May 1976 61 p refs
(Contract NAS9-14880)
(NASA-CR-151213) Avail: NTIS HC A04/MF A01 CSCL 06B

The development of a data acquisition system for noninvasive measurement of systolic time intervals is described. R-R interval from the ECG determines instantaneous heart rate prior to the beat to be measured. Total electromechanical systole (Q-S2) is measured from the onset of the ECG Q-wave to the onset of the second heart sound (S2). Ejection time (ET or LVET) is measured from the onset of carotid upstroke to the incisure. Pre-ejection period (PEP) is computed by subtracting ET from Q-S2. PEP/ET ratio is computed directly. Author

**N77-19748*#** Adrian Industries, Inc., Titusville, Fla.
**PERCUTANEOUS MULTIPLE ELECTRODE CONNECTOR, DESIGN PARAMETERS AND FABRICATION (BIOMEDICAL)**
Laurence A. Myers Feb. 1977 20 p refs
(NASA Order CC-56498-A)
(NASA-CR-144859) Avail: NTIS HC A02/MF A01 CSCL 06B

A percutaneous multielectrode connector was designed which utilizes an ultrapure carbon collar to provide an infection free biocompatible passage through the skin. The device provides reliable electrical continuity, mates and demates readily with the implant, and is fabricated with processes and materials oriented to commercial production. Author

**N77-19749*#** Virginia Univ., Charlottesville. Dept. of Physiology.
**EFFECTS ON BODY SIZE AND COMPOSITION OF CHRONIC EXPOSURE TO ALTERED GRAVITY Final Report, 1 Aug. 1973 - 31 Mar. 1977**
Grover C. Pitts Mar. 1977 103 p refs
(Grant NGR-47-005-213)
(NASA-CR-149804) Avail: NTIS HC A06/MF A01 CSCL 06P

The effects of chronic centrifugation on body composition and growth of rats, mice, monkeys, and man are studied. The benefits of exercise and restraint during acceleration are investigated. Physiological regulation and energy balance are also discussed. Author

**N77-19750*#** National Aeronautics and Space Administration. Pasadena Office, Calif.
**AUTOMATED CLINICAL SYSTEM FOR CHROMOSOME ANALYSIS Patent Application**
Kenneth Castleman (JPL), Howard J. Frieden (JPL), Elbert T. Johnson (JPL), Paul A. Rennie (JPL), and Raymond J. Wall, Inventors (to NASA) (JPL) Filed 16 May 1976 215 p
(Contract NAS7-100)
(NASA-Case-NPO-13913-1; US-Patent-Appl-SN-687251) Avail: NTIS HC A10/MF A01 CSCL 06B

An automatic chromosome analysis system is provided wherein a suitably prepared slide with chromosome spreads thereon is placed on the stage of an automated microscope. The automated microscope stage is computer operated to move the slide to enable detection of chromosome spreads on the slide. The X and Y location of each chromosome spread that is detected is stored. At the conclusion of this searching operation, the computer directs the microscope to again sequence through the chromosome spread locations in response to the stored X and Y locations. NASA

**N77-19751#** Wyoming Univ., Laramie. Dept. of Chemistry.
**PHOTO-INITIATED PROCESSES IN VISION Technical Progress Report, 1 Jul. 1975 - 30 Jun. 1976**
A. V. Guzzo 1976 8 p refs Sponsored by ERDA
(COO-1627-31) Avail: NTIS HC A02/MF A01

The photoreaction between vitamin A (and other carbonyl containing compounds) and various nitroxide spin labels was analyzed. The decrease in the label signal upon illumination is due to the photosensitization of the nitroxide resulting in the reduction of the N-O group to the N-OH group. No evidence of any carbonyl radical participation was obtained therefore a triplet-doublet energy transfer process is proposed. A similar behavior was noted for the Schiff bases of these carbonyl compounds and nitroxides. The findings do not support the idea of radical participation in the retinal isomerization process even when a good electron acceptor is present. ERA

**N77-19732#** Milan Univ. (Italy).
**INVESTIGATION OF THE EFFECT OF FREE FALL ON THE VESTIBULAR ORGAN AND OF ITS POST-FLIGHT READAPTATION AS PART OF THE SHUTTLE PROGRAM: A CONTRIBUTION TO BASIC VESTIBULAR PHYSIOLOGY AND TO THE PROBLEM OF SPACE SICKNESS**
Torquato Gualtierotti *In* AGARD Recent Advances in Space Medicine Jan. 1977 7 p refs (For primary document see N77-19731 10-51)
Avail: NTIS HC A06/MF A01

**N77-19734#** Air Force Inst. of Aviation Medicine, Fuerstenfeldbruck (West Germany).
**EXPERIMENTAL INVESTIGATIONS ON MOTION SICKNESS SUSCEPTIBILITY**
W. Hoffelt *In* AGARD Recent Advances in Space Medicine Jan. 1977 5 p refs (For primary document see N77-19731 10-51)
Avail: NTIS HC A06/MF A01

**N77-19738*#** Royal Air Force Inst. of Aviation Medicine, Farnborough (England).
**THE EFFECTS OF PROLONGED SPACEFLIGHT ON THE REGIONAL DISTRIBUTION OF FLUID, MUSCLE AND FAT: BIOSTEREOMETRIC RESULTS FROM SKYLAB**
M. W. Whittle, R. E. Herron (Texas Inst. for Rehabilitation and Res., Houston), J. R. Cuzzi (Texas Inst. for Rehabilitation and Res., Houston), and C. W. Keys (Technology Inc., Houston) *In* AGARD Recent Advances in Space Medicine Jan. 1977 5 p refs (For primary document see N77-19731 10-51)
(Contract NAS9-11604)
Avail: NTIS HC A06/MF A01

**N77-19739#** Air Force Inst. of Aviation Medicine, Fuerstenfeldbruck (West Germany).
**OPHTHALMOLOGICAL REQUIREMENTS FOR SPACELAB ASTRONAUT-SCIENTISTS**
F. J. Dauman *In* AGARD Recent Advances in Space Medicine Jan. 1977 6 p refs (For primary document see N77-19731 10-51)
Avail: NTIS HC A06/MF A01

**N77-19740#** Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Bad Godesberg (West Germany). Inst. fuer Flugmedizin.
**ATHLETIC ENDURANCE TRAINING: ADVANTAGE FOR SPACE FLIGHTS? THE SIGNIFICANCE OF PHYSICAL FITNESS FOR SELECTION AND TRAINING OF SPACELAB CREWS**
K. E. Klein, H. M. Wegmann, and P. Kuklinski *In* AGARD Recent Advances in Space Medicine Jan. 1977 13 p refs (For primary document see N77-19731 10-51)
Avail: NTIS HC A06/MF A01

**N77-19744*#** National Aeronautics and Space Administration, Washington, D.C.
**SPACE AGE HEATLH CARE DELIVERY**
Walter L. Jones *In* AGARD Recent Advances in Space Medicine Jan. 1977 9 p refs (For primary document see N77-19731 10-51)
Avail: NTIS HC A06/MF A01 CSCL 06E

# 53 BEHAVIORAL SCIENCES

Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.

**N77-19752*#** Old Dominion Univ., Norfolk, Va.
**A REVIEW OF METHODOLOGICAL FACTORS IN PERFORMANCE ASSESSMENTS OF TIME-VARYING AIRCRAFT NOISE EFFECTS**
Glynn D. Coates, Earl A. Alluisi, and C. J. Adkins, Jr. Mar. 1977 38 p refs
(Grant NsG-1092)
(NASA-CR-2789) Avail: NTIS HC A03/MF A01 CSCL 05E

Literature on the effects of general noise on human performance is reviewed in an attempt to identify (1) those characteristics of noise that have been found to affect human performance; (2) those characteristics of performance most likely to be affected by the presence of noise, and (3) those characteristics of the performance situation typically associated with noise effects. Based on the characteristics identified, a theoretical framework is proposed that will permit predictions of possible effects of time-varying aircraft-type noise on complex human performance. An annotated bibliography of 50 articles is included. Author

**N77-19741#** School of Aerospace Medicine, Brooks AFB, Tex.
**PSYCHOMETRIC CHARACTERISTICS OF ASTRONAUTS**
Bryce O. Hartman and Richard C. McNee *In* AGARD Recent Advances in Space Medicine Jan. 1977 9 p refs (For primary document see N77-19731 10-51)
Avail: NTIS HC A06/MF A01

**N77-19742#** Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Hamburg (West Germany). Inst. fuer Flugmedizin.
**PSYCHOLOGICAL SELECTION OF ASTRONAUT-SCIENTISTS (PAYLOAD SPECIALISTS)**
Klaus-Martin Goeters *In* AGARD Recent Advances in Space Medicine Jan. 1977 5 p refs (For primary document see N77-19731 10-51)
Avail: NTIS HC A06/MF A01

**N77-19743#** Royal Air Force Inst. of Aviation Medicine, Farnborough (England).
**EXPERIMENTAL BASIS FOR THE USE OF HYPNOTICS BY AEROSPACE CREWS**
A. N. Nicholson, R. G. Borland, Coral H. Clarke, and Barbara M. Stone *In* AGARD Recent Advances in Space Medicine Jan. 1977 11 p refs (For primary document see N77-19731 10-51)
Avail: NTIS HC A06/MF A01

# 54 MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

Includes human engineering; biotechnology; and space suits and protective clothing.

**N77-19753*#** Life Systems, Inc., Cleveland, Ohio.
**ADVANCED COMBINED IODINE DISPENSER AND DETECTOR Final Report**
J. B. Lantz, F. H. Schubert, F. C. Jensen, and J. D. Powell Jan. 1977 132 p refs
(Contract NAS9-14624)
(NASA-CR-151214; ER-277-4) Avail: NTIS HC A07/MF A01 CSCL 06K

A total weight of 1.23 kg (2.7 lb), a total volume of 1213 cu m (74 cu in), and an average power consumption of 5.5W was achieved in the advanced combined iodine dispenser/detector by integrating the detector with the iodine source, arranging all iodinator components within a compact package and lowering the parasitic power to the detector and electronics circuits. These achievements surpassed the design goals of 1.36 kg (3.0 lb), 1671 cu m (102 cu in) and 8W. The reliability and maintainability were improved by reducing the detector lamp power, using an interchangeable lamp concept, making the electronic circuit boards easily accessible, providing redundant water seals and improving the accessibility to the iodine accumulator for refilling. The system was designed to iodinate (to 5 ppm iodine) the fuel cell water generated during 27 seven-day orbiter missions (equivalent to 18,500 kg (40,700 lb) of water) before the unit must be recharged with iodine crystals. Author

**N77-19754*#** Massachusetts Inst. of Tech., Cambridge. Man-Vehicle Lab.
**HUMAN DYNAMIC ORIENTATION MODEL APPLIED TO MOTION SIMULATION M.S. Thesis**
Joshua D. Borah May 1976 219 p refs
(Contract NSR-22-009-701)
(NASA-CR-149862) Avail: NTIS HC A10/MF A01 CSCL 05E

The Ormsby model of dynamic orientation, in the form of a discrete time computer program was used to predict non-visually induced sensations during an idealized coordinated aircraft turn. To predict simulation fidelity, the Ormsby model was used to assign penalties for incorrect attitude and angular rate perceptions. It was determined that a three rotational degree of freedom simulation should remain faithful to attitude perception even at the expense of incorrect angular rate sensations. Implementing this strategy, a simulation profile for the idealized turn was designed for a Link GAT-1 trainer. A simple optokinetic display was added to improve the fidelity of roll rate sensations. Author

**N77-19755*#** Lockheed Electronics Co., Houston, Tex. Aerospace Systems Div.
**FEASIBILITY STUDY OF AUTOMATIC CONTROL OF CREW COMFORT IN THE SHUTTLE EXTRAVEHICULAR MOBILITY UNIT**
D. W. Cook 22 Feb. 1977 27 p
(Contract NAS9-15200)
(NASA-CR-151230; LEC-9980; TM-7001) Avail: NTIS HC A03/MF A01 CSCL 05E

Computer simulation is used to demonstrate that crewman comfort can be assured by using automatic control of the inlet temperature of the coolant into the liquid cooled garment when input to the controller consists of measurements of the garment inlet temperature and the garment outlet temperature difference. Subsequent tests using a facsimile of the control logic developed in the computer program confirmed the feasibility of such a design scheme. Author

**N77-19756*#** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
**CONTROL OF THERMAL BALANCE BY A LIQUID CIRCULATING GARMENT BASED ON A MATHEMATICAL REPRESENTATION OF THE HUMAN THERMOREGULATORY SYSTEM Ph.D. Thesis - California Univ., Berkeley**
Lawrence H. Kuznetz Oct. 1976 561 p refs
(NASA-TM-X-58190; JSC-11579) Avail: NTIS HC A24/MF A01

Test data and a mathematical model of the human thermoregulatory system were used to investigate control of thermal balance by means of a liquid circulating garment (LCG). The test data were derived from five series of experiments in which environmental and metabolic conditions were varied parametrically as a function of several independent variables, including LCG flowrate, LCG inlet temperature, net environmental heat exchange, surrounding gas ventilation rate, ambient pressure, metabolic rate, and subjective/obligatory cooling control. The resultant data were used to relate skin temperature to LCG water temperature and flowrate, to assess a thermal comfort band, to demonstrate the relationship between metabolic rate and LCG heat dissipation,

and so forth. The usefulness of the mathematical model as a tool for data interpretation and for generation of trends and relationships among the various physiological parameters was also investigated and verified. Author

**N77-19757#** Calspan Corp., Buffalo, N.Y.
**DEVELOPMENT OF A FRONT PASSENGER ASPIRATOR AIR BAG SYSTEM FOR SMALL CARS**
David J. Romer Sep. 1976 136 p refs
(Contract DOT-HS-5-01254)
(PB-259008/1; CALSPAN-ZP-5777-V-1; DOT-HS-802-039)
Avail: NTIS HC A07/MF A01 CSCL 13F

During the first year's effort an aspirator air bag system was designed and developed. Tests with the aspirator air bag system produced data which satisfied the injury criteria for the full range of adult dummy sizes through the 45 MPH crash speed range. Test results indicate that the system did not present a hazard to the forward, out-of-position child and that the results also satisfied the injury criteria for the normally seated 6 yr. old child size dummy through the 45 MPH crash range. GRA

**N77-19758#** Probe Consultants, Inc., Phoenix, Ariz.
**SAINT SIMULATION OF A REMOTELY PILOTED VEHICLE/DRONE CONTROL FACILITY: MODEL DEVELOPMENT AND ANALYSIS Final Report, Oct. 1974 - Jun. 1975**
David B. Wortman, Deborah J. Seifert, and Steven D. Duket Jun. 1976 214 p refs
(Contract F33615-75-C-5012; AF Proj. 7184)
(AD-A031085; AMRL-TR-75-118) Avail: NTIS HC A10/MF A01 CSCL 01/3

A model of a real-time simulation of a Remotely piloted Vehicle/Drone Control Facility (RPV/DCF) has been constructed using SAINT, a totally digital man-machine modeling and simulation technique. The real-time simulation consists of a mock-up of a DCF, where actual operators control the flight of simulated RPVs through the use of cathode ray tube (CRT) displays of RPB flight paths and parameters. The SAINT model consists of two interacting components. The state variable component of the model duplicated the simulation of RPV flight of the real-time simulation. The task-oriented component represents the control and decision tasks performed by the DCF operators. The interactions between the components include models of the presentation of mission status information to the operators and the processing of commands sent to the RPVs by the operators. Through input values, the generalized SAINT model is made specific to one group of operators performing one mission of the real-time simulation. This mission is simulated using SAINT. The simulation results are evaluated by comparing them with the mission performance output obtained from the real-time simulation. GRA

**N77-19759#** Bunker-Ramo Corp., Westlake Village, Calif. Electronic Systems Div.
**PILOT FACTORS CONSIDERATIONS IN SEE-TO-LAND Final Technical Report, Apr. 1974 - Jan, 1975**
William F. Swartz, Donald M. Condra, and Ralph P. Madero May 1976 52 p refs
(Contract F33615-73-C-0391; AF Proj. 6190)
(AD-A030789) Avail: NTIS HC A04/MF A01 CSCL 01/2

The aviation industry is employing a building block approach with respect to aircraft avionics in general and automatic flight control systems in particular, to move systematically from Category 1 through Category 2 to Category 3 operations. The building block approach has been quite effective in structuring what must be done in terms of equipment for delivering the aircraft reliably to the Category 1, 2 and 3 equipment minima. From an operational viewpoint, however, the recovery of the aircraft still remains a see-to-land operation for these categories. The purpose of this paper is to address the issue of how far the see-to-land concept can be extended considering the pilot factors constraints in the environment in which the problem exists. The basic question is can the pilot effectively use the equipment in what remains a see-to-land operation. The low visibility landing experiences of the USAF Flight Dynamics Laboratory and the USAF Instrument Flight Center are heavily drawn upon in the preparation of this report. The results of their flying a Head-Up Display in visibilities down to 400 feet Runway Visual Range (RVR) in a T-39 Sabreliner are reviewed and reported. In addition, a number of other relevant papers and reports are used in helping to describe the nature of the low visibility landing. An assessment is made of some solutions that are being proposed for dealing with the see-to-land problem while considering the pilot factors constraints. GRA

**N77-19733*#** Naval Aerospace Medical Research Lab., Pensacola, Fla.
**SUCCESSFUL TRANSFER OF ADAPTATION ENVIRONMENTS IN NAVY FLIGHT TRAINING**
D. B. Cramer, A. Graybiel, and W. J. Oosterveld *In* AGARD Recent Advances in Space Medicine Jan. 1977 5 p refs Sponsored by NASA (For primary document see N77-19731 10-51)
Avail: NTIS HC A06/MF A01

**N77-19735#** Air Force Inst. of Aviation Medicine, Fuerstenfeldbruck (West Germany).
**SPACE MISSION TRAINING: A NECESSARY ELEMENT IN PLANNING AND TRAINING FOR SHUTTLE SPACELAB MISSIONS**
Eduard C. Burchard *In* AGARD Recent Advances in Space Medicine Jan. 1977 13 p (For primary document see N77-19731 10-51)
Avail: NTIS HC A06/MF A01

**N77-19736#** Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Bad Godesberg (West Germany). Inst. fuer Flugmedizin.
**NEUTRAL BUOYANCY: ONE POSSIBLE TOOL FOR MAN'S TRAINING IN A SIMULATED ZERO-G ENVIRONMENT**
Heinz Oser *In* AGARD Recent Advances in Space Medicine Jan. 1977 5 p refs (For primary document see N77-19731 10-51)
Avail: NTIS HC A06/MF A01

**N77-19737#** Erno Raumfahrttechnik G.m.b.H., Bremen (West Germany).
**HUMAN ENGINEERING: CREW SYSTEMS TOOL FOR SPACELAB DESIGN**
Udo G. Munkelt (McDonnell-Douglas Corp., St. Louis) and Harold S. Jencks (McDonnell-Douglas Corp., St. Louis) *In* AGARD Recent Advances in Space Medicine Jan. 1977 9 p refs (For primary document see N77-19731 10-51)
Avail: NTIS HC A06

## 55 PLANETARY BIOLOGY

Includes exobiology and extraterrestrial life.

No abstracts in this category.

## 59 MATHEMATICAL AND COMPUTER SCIENCES (GENERAL)

No abstracts in this category.

## 60 COMPUTER OPERATIONS AND HARDWARE

Includes computer graphics and data processing.

For components see *33 Electronics and Electrical Engineering.*

**N77-19760*** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

**SELECTIVE DATA SEGMENT MONITORING SYSTEM Patent**

Manfred N. Wirth, inventor (to NASA) Issued 2 Nov. 1976 9 p Filed 12 May 1975 Supersedes N75-25127 (13 - 16, p 1965)

(NASA-Case-ARC-10899-1; US-Patent-3,990,049; US-Patent-Appl-SN-576774; US-Patent-Class-340-172.5; US-Patent-Class-178-69.5R; US-Patent-Class-179-15BS) Avail: US Patent Office CSCL 09B

High speed data monitoring apparatus is described for displaying the bit pattern of a selected portion of a block of transmitted data comprising a shift register for receiving the transmitted data and for temporarily containing the consecutive data bits. A programmable sync detector for monitoring the contents of the shift register and for generating a sync signal when the shift register contains a predetermined sync code is included. A counter is described for counting the data bits input to the shift register after the sync signal is generated and for generating a count complete signal when a selected number of data bits have been input to the register. A data storage device is used for storing the contents of the shift register at the time the count complete signal is generated.

Official Gazette of the U.S. Patent Office

**N77-19761*#** Science Applications, Inc., Atlanta, Ga.

**STUDY OF PHOTON CORRELATION TECHNIQUES FOR PROCESSING OF LASER VELOCIMETER SIGNALS Final Report**

William T. Mayo, Jr. Washington NASA Feb. 1977 111 p refs Sponsored in part by US Army Air Mobility R and D Lab., Moffett Field, Calif.

(Contract NAS1-13737; DA Proj. 1F1-61102-A-35B)

(NASA-CR-2780) Avail: NTIS HC A06/MF A01 CSCL 09B

The objective was to provide the theory and a system design for a new type of photon counting processor for low level dual scatter laser velocimeter (LV) signals which would be capable of both the first order measurements of mean flow and turbulence intensity and also the second order time statistics: cross correlation auto correlation, and related spectra. A general Poisson process model for low level LV signals and noise which is valid from the photon-resolved regime all the way to the limiting case of nonstationary Gaussian noise was used. Computer simulation algorithms and higher order statistical moment analysis of Poisson processes were derived and applied to the analysis of photon correlation techniques. A system design using a unique dual correlate and subtract frequency discriminator technique is postulated and analyzed. Expectation analysis indicates that the objective measurements are feasible. Author

**N77-19762#** California Univ., Livermore. Lawrence Livermore Lab.

**USER'S GUIDE TO THE LLL BASIC INTERPRETER**

Royce Eckard and J. Barber 2 Apr. 1976 27 p refs

(Contract W-7405-eng-48)

(UCID-17090) Avail: NTIS HC A03/MF A01

Scientists are finding increased applications for microprocessors as process controllers in their experiments. However, while microprocessors are small and inexpensive, they are difficult to program in machine or assembly language. A high-level language is needed to enable scientists to develop their own microprocessor programs for their experiments on location. Recognizing this need, LLL contracted to have such a language developed. This report describes the result - the LLL BASIC interpreter. 1 figure, 4 tables. ERA

**N77-19763#** Mound Lab., Miamisburg, Ohio.

**MICROPROCESSORS IN PROCESS CONTROL APPLICATIONS**

Francis A. Koehler, Jr. and B. E. Anderson 1976 7 p refs Presented at Monsanto Process Computer Symp., Pensacola, Fla., 8 Aug. 1976

(Contract E(33-1)-GEN-53)

(MLM-2338(OP); Conf-760827-1) Avail: NTIS HC A02/MF A01

A modular based process control system utilizing a Motorola M6800 microprocessor was installed in a process that requires the monitoring and control of very low flow rates in the ranges of 1 to 3 cu m/min of liquid and 3 to 6 liters/min of gas. To monitor the liquid flow, a 'hot wire' technique is employed. A special order turbine flowmeter is used for the gas monitoring. A direct digital control valve was built and is installed in the process. The entire process control system is completely constructed with off-the-shelf hardware and is interfaced with a commercially available multiplexer. The microprocessor system is easily adaptable, and permits a user to configure a process control system according to his immediate requirements. ERA

**N77-19764#** California Univ., Livermore. Lawrence Livermore Lab.

**SAMPLE FILE CONTROLLER: FUNCTIONAL DESCRIPTION**

Richard W. Crawford and H. S. Ames 1 Apr. 1976 34 p refs

(Contract W-7405-eng-48)

(UCRL-52047) Avail: NTIS HC A03/MF A01

A Sample File Controller designed for the analytical laboratories of the Environmental Protection Agency is described. At the heart of the system is a computer program that aids in tracking and controlling the various stages of the sampling operation -planning the sampling, taking the samples, analyzing them, and reporting the results. The necessary input data are described, such as sample locations and parameters, automated and manual analytical results, and pertinent field data. The various outputs are shown, including work load listings, interim status reports, and complete summary reports. Examples of possible operator-computer dialogs are used extensively, as well as examples of computer outputs. All the data that must be stored are described in appendices. ERA

**N77-19765#** Royal Aircraft Establishment, Farnborough (England).

**AN ADAPTATION OF THE ICL GEORGE 3 AND 4 MARK 8 CORRECTION SYSTEM TO SATISFY THE REQUIREMENTS ON ITS 1906S PROCESSOR**

F. J. Smithin 18 May 1976 29 p refs

(RAE-TM-MATH-7603; BR53324) Avail: NTIS HC A03/MF A01

A new method for making corrections to Mark 8 of ICL's George 3 and 4 operating system and the author's implementation of the scheme are described. A set of pseudo-users was created under the user George which groups, edits, and mends chapters and compilation directives. To facilitate the new edit system, two macros G4UPDATE and COMP-G4ab were developed. In order to compile non-standard versions of George 4, a macro COMP-G4MK8ab is used. The correction system was tested with Mark 8.12 and proved satisfactory. Author (ESA)

**N77-19766#** Wright State Univ., Dayton, Ohio. Human Factors Engineering.

**USING COMPUTER-GENERATED DISPLAYS FOR RESEARCH ON SYNTHESIZED DISPLAYS: DISTANCE PERCEPTION AIDED BY AERIAL PERSPECTIVE AND TEXTURE**

Diana Nelson and Malcolm Ritchie Aug. 1976 85 p refs

(Contract F33615-75-C-5146; ARPA Order 2889; AF Proj. 2313)

(AD-A030589; HFE-76-3; AMRL-TR-76-34) Avail: NTIS HC A05/MF A01 CSCL 09/2

This report relates to an evolving capability to faithfully duplicate real world scenes on cathode ray tubes on the basis of numerical models and data stored and processed by digital computers. The potential accuracy and detail of such computer-generated imagery are virtually unlimited assuming appropriate computational power and software are provided. The research described is part of an effort to develop a basis for assuring that future computer-generated display features are consistent with cost and user information requirements. Experienced air crew members and university students estimated distances on the basis of quantitatively defined visual cues included in computer-generated displays. Estimates were obtained for eight different distances depicted by variations in the position and size of an object of specified dimensions. The object was rectangular in shape, blue in color, and appeared on a green background. The distances represented were 3,000; 5,000; 8,000;

12,000; 17,000; 23,000;; 30,000; and 38,000 feet. Two additional features of the computer-generated displays were investigated as independent variables: (1)aerial perspective at four levels of visibility, or fog, and (2) background texture. The background texture was produced by stripes of different shades of green overlaid at right angles to form a random pattern. Three levels of texture were generated by depicting stripes 1000, 2000, and 4000 feet in width. GRA

**N77-19767#** Naval Electronics Lab. Center, San Diego, Calif.
**A CHARGE-COUPLED DEVICE (CCD) MEMORY FOR NAVY C3 SYSTEMS Research and Development Report, Jul. 1975 - Jul. 1976**
J. J. Symanski 30 Jul. 1976 40 p
(NELC Proj. N712; SF21241401)
(AD-A030902; NELC/TR-2001) Avail: NTIS HC A03/MF A01 CSCL 09/2

A prototype memory system using 16 thousand-bit charge-coupled devices and a microprocessor controller has been designed and tested. Features include a modular, expandable architecture, error detection and correction, NTDS input and output, and SHP packaging. Author (GRA)

**N77-19768#** Federal COBOL Compiler Testing Service, Washington, D.C.
**LOW-INTERMEDIATE PDP-11/70, PDP-11 COBOL COMPILER V 2.0 Validation Summary Report**
8 Oct. 1976 39 p
(AD-A031019; CCVS74-VSR160) Avail: NTIS HC A03/MF A01 CSCL 09/2

This Validation Summary Report (VSR) for the Digital Equipment Corporation PDP-11/70 Series, PDP-11 COBOL Compiler Version 2.0 provides a consolidated summary of the results obtained from the validation of the subject compiler against the 1974 (FIPS PUB 21-1). The VSR is made up of several sections showing the discrepancies found. These include an overview of the validation which lists all categories of discrepancies by Federal level module; a section relating the categories of discrepancies to each of the Federal levels of the language; and a detailed listing of discrepancies together with the tests which were failed. GRA

**N77-19769#** Lincoln Lab., Mass. Inst. of Tech., Lexington.
**DVT DIAGNOSTIC SYSTEM**
Richard I. Tucker and Maurice Daniel 19 Jul. 1976 269 p
(Contract F19628-76-C-0002; AF Proj. 7820)
(AD-A029413; TN-1976-4; ESD-TR-76-214) Avail: NTIS HC A12/MF A01 CSCL 09/2

A diagnostic system for the Lincoln Digital Voice Terminal (LDVT) is described. The LDVT's diagnostic system consists of a series of programs to check the operation of all hardware as well as control programs for either the UNIVAC-1219 or PDP-11 computer serving as host. A self-contained diagnostic exerciser is also described. All fault condition codes are tabulated for easy deciphering. Author (GRA)

**N77-19770#** Stanford Research Inst., Menlo Park, Calif.
**SYMPOSIUM ON ADVANCED MEMORY CONCEPTS Final Report**
Stephen W. Miller and Ugo O. Gagliardi (Gagliardi Systems Group, Inc.) Jun. 1976 680 p refs Symp. held at Menlo Park, Calif., 22-26 Mar. 1976
(Contract N00014-76-C-0371; SRI Proj. 4860)
(AD-A029631) Avail: NTIS HC A99/MF A01 CSCL 09/2

Early in FY 1975, in response to projected DoD needs, the Information Processing Technology Office of the Advanced Research Projects Agency (ARPA) initiated work on the Advanced Memory Concepts (AMC) program which addresses hardware aspects of the memory technology problem. The objectives of the AMC program are to investigate, characterize, and develop as appropriate the fundamental physical concepts that contribute to the efficient storage and retrieval of information, as well as the concomitant computer architecture and organization required to realize the best advantages of the new concepts in the 1985-95 time period. As a part of the AMC program, a workshop (or symposium) was conducted during March 1976 to articulate a concerted series of recommended research directions for inclusion in the AMC program. GRA

**N77-19771#** Naval Ship Research and Development Center, Bethesda, Md. Computation and Mathematics Dept.
**GRAPHICS DATA REDUCTION AND DESIGN STATION USERS MANUAL**
Ruey Chen and Rita F. Shore Jul. 1976 61 p refs
(SF53532020)
(AD-A030341; CMD-11-76) Avail: NTIS HC A04/MF A01 CSCL 09/2

This document is a reference manual on the use of the Graphics Data Reduction and Design Station (GDRDS) available at the David W. Taylor Naval Ship Research and Development Center. The GDRDS enables the user to digitize points from engineering drawings in an interactive graphics environment. Described are the hardware (digitizing board, CRT scope and minicomputer) and the software provided. Author (GRA)

**N77-19772#** Stanford Univ., Calif. Dept. of Operations Research.
**OPTIMAL CONTROL OF A BROWNIAN STORAGE SYSTEM**
J. Michael Harrison and Allison J. Taylor 1 Sep. 1976 37 p refs
(Contract N00014-76-C-0418; Grant NSF ENG-75-14847; NR Proj. 047-061)
(AD-A030650; SU-TR-69) Avail: NTIS HC A03/MF A01 CSCL 12/2

Consider a storage system (such as an inventory or bank account) whose content fluctuates as a Brownian Motion X = (X(t), t greater than or equal to 0) in the absence of any control. Let Y = (Y(t), t greater than or equal to 0) and Z = (Z(t), t greater than or equal to 0) by nondecreasing, non-anticipating functionals representing the cumulative input to the system and cumulative output from the system respectively. The problem is to choose Y and Z so as to maximize expected discounted reward subject to the requirement that X(t) + Y(t) - Z(t) greater than or equal to 0 for all t greater than or equal to 0 almost surely. In the first formulation, it is assumed that a reward of one dollar is received for every unit of output, while a cost of k> 1 dollars is incurred for every unit of input. An optimal policy involving a single critical number is computed. In the second formulation, the cumulative input Y is required to be a step function, and an additional cost of K>0 dollars is incurred each time that an input jump occurs. An optimal policy involving two critical numbers is then computed. Applications to inventory/production control and stochastic cash management are discussed. Author

**N77-19104*#** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**DSN AUTOMATION**
R. B. Crow *In its* The Deep Space Network 15 Feb. 1977 p 88-104 (For primary document see N77-19091 10-12)
Avail: NTIS HC A13/MF A01 CSCL 09B

**N77-19105*#** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**AUTOMATED FOURTH-HARMONIC ANALYZER**
C. F. Foster *In its* The Deep Space Network 15 Feb. 1977 p 105-111 (For primary document see N77-19091 10-12)
Avail: NTIS HC A13/MF A01 CSCL 09B

**N77-19106*#** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**CONTROL AND COMPUTATION MODULE DEVELOPMENT**
R. A. Winkelstein *In its* The Deep Space Network 15 Feb. 1977 p 112-117 refs (For primary document see N77-19091 10-12)
Avail: NTIS HC A13/MF A01 CSCL 09B

**N77-19109*#** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**EVALUATION OF DSN DATA PROCESSING WITH 7200-b/s GCF HIGH-SPEED DATA INTERFACES**
H. C. Thorman *In its* The Deep Space Network 15 Jul. 1977 p 132-135 ref (For primary document see N77-19091 10-12)
Avail: NTIS HC A13/MF A01 CSCL 09B

# 61 COMPUTER PROGRAMMING AND SOFTWARE

Includes computer programs, routines, and algorithms.

**N77-19773*#** Houston Univ., Tex. Dept. of Mathematics.
**A REVIEW OF THE LEC PERFORMANCE EVALUATION OF UHMLE**
Henry P. Decell, Jr. and William A. Coberly (Tulsa Univ.) Jan. 1977 19 p refs
(Contract NAS9-15000)
(NASA-CR-151236; Rept-62) Avail: NTIS HC A02/MF A01 CSCL 09B

Several candidate signature extensions algorithms were evaluated. Four simulated data sets and seven consecutive day data sets were used. Analysis and evaluation of the UHMLE test and recommendations on changes in the UHMLE algorithm motivated by the test are given for each data set. The criterion for evaluation of each algorithm was overall classification accuracy. Author

**N77-19774*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
**VARIANTS AND EXTENSIONS OF A FAST DIRECT NUMERICAL CAUCHY-RIEMANN SOLVER, WITH ILLUSTRATIVE APPLICATIONS**
E. Dale Martin and Harvard Lomax Washington Mar. 1977 101 p refs
(NASA-TN-D-7934; A-5988) Avail: NTIS HC A06/MF A01 CSCL 09B

Revised and extended versions of a fast, direct (noniterative) numerical Cauchy-Riemann solver are presented for solving finite difference approximations of first order systems of partial differential equations. Although the difference operators treated are linear and elliptic, one significant application of these extended direct Cauchy-Riemann solvers is in the fast, semidirect (iterative) solution of fluid dynamic problems governed by the nonlinear mixed elliptic-hyperbolic equations of transonic flow. Different versions of the algorithms are derived and the corresponding FORTRAN computer programs for a simple example problem are described and listed. The algorithms are demonstrated to be efficient and accurate. Author

**N77-19775*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**A PDP-15 TO INDUSTRIAL-14 INTERFACE AT THE LEWIS RESEARCH CENTER'S CYCLOTRON**
Francis R. Kebberly and Regis F. Leonard Mar. 1977 21 p refs
(NASA-TM-X-73604; E-9077) Avail: NTIS HC A02/MF A01 CSCL 09B

An interface (hardware and software) was built which permits the loading, monitoring, and control of a digital equipment industrial-14/30 programmable controller by a PDP-15 computer. The interface utilizes the serial mode for data transfer to and from the controller, so that the required hardware is essentially that of a teletype unit except for the speed of transmission. Software described here permits the user to load binary paper tape, read or load individual controller memory locations, and if desired turn controller outputs on and off directly from the computer. Author

**N77-19776*#** Martin Marietta Corp., Denver, Colo.
**CAPABILITIES AND APPLICATIONS OF THE PROGRAM TO OPTIMIZE SIMULATED TRAJECTORIES (POST). PROGRAM SUMMARY DOCUMENT**
G. L. Brauer, D. E. Cornick, and R. Stevenson Washington NASA Feb. 1977 132 p refs
(Contract NAS1-13611)
(NASA-CR-2770) Avail: NTIS HC A07/MF A01 CSCL 09B

The capabilities and applications of the three-degree-of-freedom (3DOF) version and the six-degree-of-freedom (6DOF) version of the Program to Optimize Simulated Trajectories (POST) are summarized. The document supplements the detailed program manuals by providing additional information that motivates and clarifies basic capabilities, input procedures, applications and computer requirements of these programs. The information will enable prospective users to evaluate the programs, and to determine if they are applicable to their problems. Enough information is given to enable managerial personnel to evaluate the capabilities of the programs and describes the POST structure, formulation, input and output procedures, sample cases, and computer requirements. The report also provides answers to basic questions concerning planet and vehicle modeling, simulation accuracy, optimization capabilities, and general input rules. Several sample cases are presented. Author

**N77-19777#** California Univ., Berkeley. Lawrence Berkeley Lab. Dept. of Computer Science and Applied Mathematics.
**PROFESSIONAL LEVELS OF COMPUTER PROGRAM DOCUMENTATION**
Fredric Gey 1 Jun. 1976 18 p refs Presented at Pacific Regional Symp., Seattle, 24 Jun. 1976
(Contract W-7405-eng-48)
(LBL-4876; Conf-760634-3) Avail: NTIS HC A02/MF A01

Computer program documentation is more than a collection of techniques for manipulating code for readability, more than a flow diagram of program logic, and more than a block of comments cards at the beginning of a module. A professional level of documentation derives from the systematic synthesis of technique tempered with good judgment and lucid composition. The overriding goal of documentation is understanding, by managers, by users, and by maintenance programmers. Documentation requires a level of precision rarely required in programming itself. ERA

**N77-19778#** Ames Lab., Iowa.
**ALECS NUMERICAL SUBROUTINE LIBRARY**
Kenneth R. Crouse and Dennis V. Jensen Jun. 1976 50 p refs
(Contract W-7405-eng-82)
(IS-3937) Avail: NTIS HC A03/MF A01

The optimized hardware floating-point versions of the built-in numerical subroutines used in the ALECS language are described. Information as to the algorithm used, the implementation conventions, and the accuracy of the results is provided for each subroutine. Accompanying each subroutine description is a flowchart of the implementation and a set of sample results. Possible error conditions are noted and the corresponding error codes are given. ERA

**N77-19779#** Oak Ridge National Lab., Tenn.
**USER'S GUIDE FOR ICE**
S. K. Fraley Jul. 1976 18 p refs
(Contract W-7405-eng-26)
(ORNL/CSD/TM-9) Avail: NTIS HC A02/MF A01

ICE is a cross-section mixing code which will accept cross sections from an AMPX working library and produce mixed cross sections in the AMPX working library format, ANISN format, and the group-independent ANISN format. User input is in the freeform or fixed-form FIDO structure. The code is operable as a module in the AMPX system. ERA

**N77-19780#** Sandia Labs., Albuquerque, N.Mex.
**WULFF: A SET OF COMPUTER PROGRAMS FOR THE LARGE DISPLACEMENT DYNAMIC RESPONSE OF THREE-DIMENSIONAL SOLIDS**
Johnny H. Biffle and Matt H. Gubbels Aug. 1976 56 p refs
(Contract E(29-1)-789)
(SAND-76-0096) Avail: NTIS HC A04/MF A01

WULFF is a set of computer programs designed to generate a three-dimensional finite element mesh, input boundary conditions and material descriptions, solve the problem, and then graphically display the results. ERA

**N77-19781#** California Univ., Berkeley. Lawrence Berkeley Lab.
**INTRODUCTION TO BLIMP, A SYSTEMS PROGRAMMING LANGUAGE FOR THE CDC 6000/7000 CPUS**
Leo S. Vardas 1 Apr. 1976 3 p Presented at the VIM 24 Conf., San Francisco, 6 Apr. 1976
(Contract W-7405-eng-48)
(LBL-4828; Conf-760476-1) Avail: NTIS HC A02/MF A01

BLIMP is a systems programming language for the CDC 6000/7000 CPU's. It was developed primarily for the implementa-

tion of procedures which deal with data items, or fields, in tables of the type typically found in operating systems. The language incorporates the concepts of structured programming both in its control constructs and in the techniques of code generation and optimization. The 6000 System deadstart loader, the associated HELP utility, a macroprocessor, a metacompiler, the compiler itself, and an assortment of utilities have been implemented in BLIMP. ERA

**N77-19782#** Grimes (W. J.) and Co., Hingham, Mass.
**PRELIMINARY REPORT ON SIMULATION OF A HELIOSTAT FIELD**
G. Bouyssou, A. Giraud, and G. Vialaret Jun. 1976 27 p Transl. into ENGLISH of "Rapport provisoire sur la simulation d'un champ D'heliostats", Toulouse, Natl. Scientific Res. Center, 22 Jul. 1975 Sponsored by ERDA
(ERDA-TR-158) Avail: NTIS HC A03/MF A01

Structuring with specialized subprograms provides a very high degree of flexibility depending on the acquisition of increasingly accurate data for the selected site, the mechanical and optical design of the mirrors, the data on solar radiation, the tower and boiler, the number of towers, and random disturbances. These data can be integrated into any stimulation in order to obtain results which come closer and closer to reality. ERA

**N77-19783#** Stanford Univ., Calif. Dept. of Computer Science.
**EXPLORATORY STUDY OF COMPUTER INTEGRATED ASSEMBLY SYSTEMS**
T. O. Binford, D. D. Grossman, C. R. Liu, R. C. Bolles, and R. A. Finkel 1976 342 p refs Sponsored by NSF
(PB-259130/3; NSF/RA-760256) Avail: NTIS HC A15/MF A01 CSCL 13H

The project is concerned with developing the software technology of programmable assembly devices, including computer controlled manipulators and vision systems. A complete hardware system was implemented that includes manipulators with tactile sensors and TV cameras, tools, fixtures, and auxiliary devices, a dedicated minicomputer, and a time shared large computer equipped with graphic display terminals. An advanced software system called AL was developed that can be used to program assembly applications. Research currently underway includes refinement of AL, development of improved languages and interactive programming techniques for assembly and vision, extension of computer vision to areas which are currently infeasible, geometric modeling of objects and constraints, assembly simulation, control algorithms, and adaptive methods of calibration. GRA

**N77-19784#** TRW Defense and Space Systems Group, Redondo Beach, Calif.
**SOFTWARE RELIABILITY STUDY Final Technical Report, 16 Oct. 1973 - 27 Feb. 1976**
T. A. Thayer, G. R. Craig, L. E. Frey, W. L. Hetrick, and M. Lipow Griffiss AFB, N. Y. RADC Aug. 1976 346 p refs
(Contract F30602-74-C-0036; AF Proj. 5581)
(AD-A030798; TRW-76-2266.1.9-5; RADC-TR-76-238) Avail: NTIS HC A15/MF A01 CSCL 09/2

A study of software errors is presented. Techniques for categorizing errors according to type, identifying their source, and detecting them are discussed. Various techniques used in analyzing empirical error data collected from four large software systems are discussed, and results of analysis are presented. Use of results to indicate improvements in the error prevention and detection processes through use of tools and techniques is also discussed. GRA

**N77-19785#** Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.
**LAMBDA: THE ULTIMATE IMPERATIVE**
Guy Lewis Steele, Jr. and Gerald Jay Sussman Mar. 1976 43 p refs
(Contract N00014-75-C-0643)
(AD-A030751; AI-M-353) Avail: NTIS HC A03/MF A01 CSCL 09/2

This report demonstrates how to model the following common programming constructs in terms of an applicative order language similar to LISP: Simple Recursion; Iteration; Compound Statements and Expressions; GO TO and Assignment; Continuation-Passing; Escape Expressions; Fluid Variables; and Call by Name, Call by Need, and Call by reference. The models require only (possibly self-referent) lambda application, conditionals, and (rarely) assignment. No complex data structures such as stacks are used. The models are transparent, involving only local syntactic transformations. Some of these models, such as those for GO TO and assignment, are already well known, and appear in the work of Landin, Reynolds, and others. The models for escape expressions, fluid variables, and call by need with the side effects are new. This paper is partly tutorial in intent, gathering all the models together for purposes of context. Author (GRA)

**N77-19786#** Naval Surface Weapons Center, Dahlgren, Va.
**ANALYSIS OF RECORD BLOCK CHAINS FOR THE CDC 6700 Final Report**
Alfred H. Morris, Jr. Aug. 1976 87 p refs
(AD-A030671; NSWC/DL-TR-3534) Avail: NTIS HC A05/MF A01 CSCL 09/2

This report gives a detailed description of a program, currently in operation at NSWC/DL, that determines if the permanent files are properly stored and catalogued on the CDC 6700 computer. The program serves only in a diagnostic capacity. Its purpose is not to correct errors, but only to find and report them. such a program is needed since system malfunctions can occur. The documentation is intended primarily for system analysts. The report defines each task that is involved, and examines the coding that performs the task. Background information is provided when needed. The program is for the SCOPE 3.4.3 operating systems. Author (GRA)

**N77-19787#** Naval Medical Research Inst., Bethesda, Md.
**ITERATIVE PARAMETER ESTIMATION Progress Report**
R. Clifton Bailey and Louis D. Homer Sep. 1976 28 p refs
(AD-A030611) Avail: NTIS HC A03/MF A01 CSCL 09/2

The report describes a non-linear least squares program and a maximum likelihood program for use by persons without extensive statistical or computer experience. Both programs are written in the BASIC computer language. Author (GRA)

**N77-19788#** Desmatics, Inc., State College, Pa.
**A SMALL-SCALE INVESTIGATION OF STATISTICS FOR DETERMINING THE NUMBER OF CLUSTERS IN A DATA BASE**
Dennis E. Smith and Robert L. Gardner Sep. 1976 28 p refs
(Contracts N00014-74-C-0154; N00014-75-C-1054;
NR Proj. 105-757; NR Proj. 042-334)
(AD-A030586; TR-102-3) Avail: NTIS HC A03/MF A01 CSCL 09/2

In construction of a predictive mathematical model of impact acceleration injury, changes in evoked potential response may serve to provide important information. In attempting to determine whether a number of different types of changes exist, cluster analysis may be used. This report describes a limited Monte Carlo examination of four statistics (used in conjunction with Ward's hierarchical clustering algorithm) for identifying the number of clusters built into a simulated ten-dimensional data space. Author (GRA)

**N77-19789#** Michigan Univ., Ann Arbor. Dept. of Electrical and Computer Engineering.
**A SIMULATOR PROGRAM FOR TSS Interim Report, 1 Jul. 1972 - 30 Sep. 1975**
Dec. 1975 179 p refs
(Contract F30602-73-C-0001; AF Proj. 5581)
(AD-A030956; RADC-TR-75-313) Avail: NTIS HC A09/MF A01 CSCL 09/2

This report describes the computer program and its implementation which simulates the Honeywell Time Sharing System (Version 8) operating on the Honeywell 635. The program (model) simulates the behavior of Subsystem programs and the efforts of the scheduling policies of the Time Sharing System. The simulation program is written in Simscript II programming language. GRA

**N77-19790#** Stanford Univ., Calif. Systems Optimization Lab.
**USERS GUIDE FOR LCPL. A PROGRAM FOR SOLVING**

**LINEAR COMPLEMENTARITY PROBLEMS BY LEMKE'S METHOD**
J. A. Tomlin Aug. 1976 37 p ref
(Contracts N00014-75-C-0865; DAAC29-74-C-0034; NR Proj. 047-143)
(AD-A030692; SU-SOL-76-16) Avail: NTIS HC A03/MF A01 CSCL 12/2

This document is a users guide for LCPL, an efficient robust program for solving Linear Complementarity Problems by Lemke's method. Author (GRA)

**N77-19791#** Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Systems and Logistics.
**THE EFFECTS OF DEVELOPMENTAL SOFTWARE ON THE ACQUISITION MANAGEMENT OF AERONAUTICAL COMPUTER SYSTEMS M.S. Thesis**
James R. Marshall and Craig E. Chapman Jun. 1976 128 p refs
(AD-A030217; SLSR-13-76A) Avail: NTIS HC A07/MF A01 CSCL 09/2

The purpose of this research was to determine if the developmental software aspect of aeronautical computer system acquisitions was the cause of program cost overruns and schedule extensions. The hypothesis was that developmental software does cause program cost and schedule overruns. A structured interview was used to obtain data concerning three variable characteristics of developmental software: software documentation, software design and interface requirements, and software testing (validation and verification). A census of all on-going programs at Aeronautical System Division, Wright-Patterson AFB, Ohio, as of 1 January 1976, was performed. Criteria tests on the correlation of data with program cost and schedule changes was conducted to establish support for the hypothesis. The hypothesis could not be supported. Additional analysis coupled with observations compiled during the interviews indicated that it may not be the case that aeronautical weapon system acquisitions are being approached from a total system point of view, but rather that subsystems are being optimized to the detriment of the total weapon system acquisition. The authors feel that this suboptimization is a contributing cause to cost overruns and schedule extensions. Recommendations for further research are included. GRA

**N77-19792#** University of Southern Calif., Marina del Rey. Information Sciences Inst.
**ABSTRACTION AND VERIFICATION IN ALPHARD: ITERATION AND GENERATORS**
Mary Shaw, William A. Wulf, and Ralph L. London 20 Aug. 1976 48 p refs
(Contracts DAHC15-72-C-0308; F44620-73-C-0074; ARPA Order 2223)
(AD-A030286; ISI/RR-76-47) Avail: NTIS HC A03/MF A01 CSCL 09/2

The Alphard form provides the programmer with a great deal of control over the implementation of abstract data types. In this report we extend the abstraction techniques from simple data representation and function definition to the iteration statement, the most important point of interaction between data and the control structure of the language itself. We introduce a means of specializing Alphard's loops to operate on abstract entities without explicit dependence on the representation of those entities. We develop specification and verification techniques that allow the properties of such iterations to be expressed in the form of proof rules. We also provide a means of showing that a generator will terminate and obtain results for common special cases that are essentially identical to the corresponding constructs in other languages. Author (GRA)

**N77-19793#** Federal COBOL Compiler Testing Service, Washington, D.C.
**UNIVAC SERIES 90 COBOL V48E, VS/9 RELEASE 2**
23 Sep. 1976 27 p
(AD-A030222; CCVS68-VSR155) Avail: NTIS HC A03/MF A01 CSCL 09/2

This Validation Summary Report (VSR) for the UNIVAC Series 90 COBOL V48E, VS/9 Release 2 provides a consolidated summary of the results obtained from the validation of the subject compiler against the 1968 COBOL Standard (FIPS PUB 21). The VSR is made up of several sections showing the discrepancies found. These include an overview of the validation which lists all categories of discrepancies by Federal level module; a section relating the categories of discrepancies to each of the Federal levels of the language; and a detailed listing of discrepancies together with the tests which were failed. Author (GRA)

**N77-19794#** Defense Communications Engineering Center, Reston, Va.
**SOL-370 INSTALLATION AND ERROR TRACING GUIDE**
H. Ulfers Aug. 1976 19 p refs
(AD-A029446; TN-23-76) Avail: NTIS HC A02/MF A01 CSCL 09/2

This report contains instructions for detection and tracing of errors which occur during execution of simulation models implemented with the SOL-370 Simulation System. It also gives instructions for the installation and initial testing of the system. GRA

**N77-19795#** Softech, Inc., Waltham, Mass.
**AN EXPLORATORY STUDY OF REASONS FOR HOL OBJECT CODE INEFFICIENCY Final Report, Mar. - May 1976**
John B. Goodenough Aug. 1976 73 p refs
(Contract DAAB07-75-C-0373)
(AD-A029664; ECOM-75-0373-F; Rept-1021-11.1) Avail: NTIS HC A04/MF A01 CSCL 09/2

This report describes an exploratory study of some executive and tactical programs written in a high order language. The objective of the study was to determine the extent to which object code inefficiencies are affected by the design of a programming language, a compiler's optimization strategies, and how the language is used (programming style). Specific examples of program segments are analyzed together with object code produced by a compiler for a specific military computer. The most significant finding is that in tactical programming, at least, source code readability and maintainability are strongly affected by a compiler's optimization strategies when object code efficiency is important, and consequently, the effect of these strategies on programming style needs to be given much more careful attention than is currently the case. Author (GRA)

**N77-19796#** Mitre Corp., Bedford, Mass.
**AIR FORCE PROGRAMMING LANGUAGES: STANDARDS USE, AND SELECTION**
L. J. LaPadula and P. L. Loring L. G. Hanscom Field, Mass. ESD Aug. 1976 143 p refs
(Contract F19628-76-C-0001; AF Proj. 572A; AF Proj. 2237)
(AD-A029749; MTR-3169; ESD-TR-76-140) Avail: NTIS HC A07/MF A01 CSCL 09/2

The Air Force Systems Command(AFSC) High Order Language (HOL) Standardization Program is intended to develop recommendations in HOL standardization and to provide a standardization policy implementation plan. In support of this program a summary of information gathered on Air Force programming language is presented in this report. The programming languages are those used in weapon and defense system applications, which are grouped into six application areas. Each functional area, its subareas, and its requirements are described: programming languages used within each functional area are identified and their characteristics and associated standards and environments are described. This report, which is a follow-on to MITRE WP-20334, includes refinements of the information contained in that working paper; these refinements are the result of review of WP-20334 by many interested people within the Air FOrce. A preliminary standardization position for AFSC is given in the conclusions section of this report. Author (GRA)

**N77-19797#** Dayton Univ. Research Inst., Ohio.
**VERSATILE MANOVA: DESIGN AND DOCUMENTATION Final Report**
Thomas R. Schori Aug. 1976 91 p refs
(Contract DABT01-76-C-0212)
(AD-A030052; USAARL-76-26) Avail: NTIS HC A05/MF A01 CSCL 09/2

Recognizing the complexity inherent in human performance, investigators typically utilize multiple dependent variables in human factors or ergonomics research. It is apparent from the literature, though, that they often employ a series of univariate analyses

to analyze their data, when a single multivariate analysis would be appropriate. In many cases, the investigator may be aware that a multivariate analysis should be employed. However, the appropriate multivariate analysis may never have been described or it may produce results which the investigator is unable to interpret. Therefore, the investigator must resort to a series of univariate analyses. To rectify this situation, the writer prepared the computer program Versatile MANOVA, a copy of which is included in the Appendix. GRA

**N77-19798#** Naval Postgraduate School, Monterey, Calif.
**ANALYSIS OF PROGRAM STRUCTURE AND ERROR CHARACTERISTICS AS APPLIED TO NTDS PROGRAMS M.S. Thesis**
Michael Kirchgaessner Jun. 1976 106 p refs
(AD-A030041) Avail: NTIS HC A06/MF A01 CSCL 09/2

A simulation model for the evaluation of program structure and error detection has been applied to the analysis of selected parts of NTDS programs. The simulation results were used to establish the relationship between program structure and measures of program complexity. This information would be used for the design and testing of software. Author (GRA)

**N77-19799#** California Univ., Los Angeles. School of Engineering and Applied Science.
**A COMPUTER-ORIENTED APPROACH TO FAULT-TREE CONSTRUCTION Topical Report No. 1**
S. L. Salem, G. E. Apostolakis, and D. Okrent Nov. 1976 278 p refs Sponsored by EPRI
(PB-260765/3; EPRI-NP-288) Avail: NTIS HC A13/MF A01 CSCL 18I

A methodology for systematically constructing fault trees for general complex systems is developed and applied, via the computer program CAT, to several systems. A means of representing component behavior by decision tables is presented. A procedure for constructing and editing fault trees, either manually or by computer, is described. The computer program CAT has been developed and used to construct fault trees for two systems and to verify the methodology. GRA

**N77-19103*#** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**ON THE INHERENT INTRACTABILITY OF FINDING GOOD CODES**
R. J. McEliece and H. C. A. VanTilborg *In its* The Deep Space Network 15 Feb. 1977 p 83-87 refs (For primary document see N77-19091 10-12)
Avail: NTIS HC A13/MF A01 CSCL 09B

## 62 COMPUTER SYSTEMS

Includes computer networks.

**N77-19800#** California Univ., Livermore. Lawrence Livermore Lab.
**ANALYSIS OF TWO MICRO-PROGRAMMABLE MINI-COMPUTER SYSTEMS**
Tadashi Kishi 16 Apr. 1976 18 p refs
(Contract W-7405-eng-48)
(UCRL-52064) Avail: NTIS HC A02/MF A01

Cost-effective, alternative solutions are sought to a class of computational problems not suited to major vector and parallel computer systems. The effectiveness of micro-programmable, minicomputer systems was explored using a traditional microprocessor and an unconventional, special-purpose microprogrammable array processor. It was found that the microprocessor provided a convenient and powerful way to experiment with new architecture by soft design techniques and that the array processor can be redesigned into a cost-effective, high-performance computer system. ERA

**N77-19801#** Boston Coll., Chestnut Hill, Mass. Space Data Analysis Lab.
**DATA PROCESSING SYSTEM DEVELOPMENT FOR AN AIR FORCE SATELLITE Final Report, 1 Feb. 1973 - 31 Jan. 1976**
Dennis E. Delorey 29 Feb. 1976 97 p
(Contract F19628-73-C-0137)
(AD-A029440; BC-SDAL-76-3; AFGL-TR-76-0121) Avail: NTIS HC A05/MF A01 CSCL 22/2

A data processing system was developed for the reduction and analysis of transmitted signals from an Air Force satellite. Flow of data through the system is described, and program interfaces are defined. Experiments flown aboard the spacecraft are briefly described, and the processing routines used to construct data bases are elaborated. File formats for data bases created at all phases of the processing system are defined. GRA

**N77-19802#** Pritsker and Associates, Inc., West Lafayette, Ind.
**NEW DEVELOPMENTS IN SAINT: THE SAINT 3 SIMULATION PROGRAM Final Report, Oct. 1974 - Jun. 1975**
David B. Wortman, Deborah J. Seifert, and Steven D. Duket Wright-Patterson AFB, Ohio AMRL Jun. 1976 112 p refs
(Contract F33615-75-C-5012; AF Proj. 7184)
(AD-A029894; AMRL-TR-75-117) Avail: NTIS HC A06/MF A01 CSCL 09/2

A network modeling and simulation technique called SAINT III has been developed to model and analyze, via a computer simulation approach, complex man-machine systems. SAINT III incorporates the capability for including discrete and continuous elements in a model, as well as interactions between the two. SAINT III obtains system performance measures for models that represent a set of ordered tasks performed by a crew of operators having individual characteristics. In addition, human engineering considerations are included in a model by means of task parameter specifications, task precedence and sequencing relations, and psycho-social and environmental factors affecting operator performance. This report describes the new capabilities included in the SAINT III simulation program. Techniques have been incorporated for the specification of moderator functions, the generation of user-specified input and output, the use of operator and system attributes, and the definition of general task characteristics. In addition, modifications and deletions of SAINT II program capabilities are described. Author (GRA)

**N77-19803#** Computer Sciences Corp., Falls Church, Va.
**NSW GCOS CONNECTION Interim Report, 22 Mar. - 12 Jun. 1976**
Robert J. Grimes Griffiss AFB, N. Y. RADC Jul. 1976 96 p
(Contract F30602-76-C-0199; AF Proj. 5550)
(AD-A030508; RADC-TR-76-228) Avail: NTIS HC A05/MF A01 CSCL 09/2

This report provides a detailed examination of four specific alternatives providing an interface between the Honeywell H6180 (GCOS) and the ARPANET. The ultimate goal is to allow the H6180 to participate in the National Software Works (NSW) as a Tool Bearing Host (TBH). A configuration consisting of the H6180, Asynchronous Bit Serial Interface (ABSI), a PDP-11 operating as a network front-end (NFE) and the network IMP comprised the best alternative. Author (GRA)

## 63 CYBERNETICS

Includes feedback and control theory.

For related information see also *54 Man/System Technology and Life Support*.

**N77-19804#** Pattern Analysis and Recognition Corp., Rome, N.Y.
**APPLICATION OF PATTERN ANALYSIS AND RECOGNITION TO I AND W Final Technical Report, Mar. 1975 - Jan. 1976**
Christopher Landauer, John Morris, Clinton Mah, John Sanders, Frank Blackburn, and David Bennett Griffiss AFB, N. Y. RADC Jul. 1976 69 p
(Contract F30602-75-C-0157; AF Proj. 4594)
(AD-A029395; PAR-76-3; RADC-TR-76-226) Avail: NTIS HC A04/MF A01 CSCL 09/2

The goal of the initial three-month feasibility study reported here has been the design and testing of critical components of the Message Extraction Through Estimated Relevance (METER) System. Description of the designs and tests are included in this report. In addition, background materials concerning the goals

of the project are presented, together with a description of associative methods for document analysis and classification. Finally, a theoretical discussion introduces questions for which additional research will be required. Reference is made to the RADC Automatic Document Classification On-Line (RADCOL) system, which furnished initial designs for METER components. An evaluation of the RADCOL system is provided in RADC-TR-75-208. Author (GRA)

**N77-19805#** Stanford Univ., Calif. Dept. of Statistics.
**THE INFORMATION IN CONTINGENCY TABLES: AN APPLICATION OF INFORMATION-THEORETIC CONCEPTS TO THE ANALYSIS OF CONTINGENCY TABLES**
C. T. Ireland (George Washington Univ., Washington, D. C.) and S. Kullback 4 Aug. 1976 85 p refs
(Contract N00014-76-C-0475; NR Proj. 042-267)
(AD-A030695; SU-TR-235) Avail: NTIS HC A05/MF A01 CSCL 12/1

The analysis of the information in contingency tables is an aspect of multivariate (multiple variates) analysis with particular application to qualitative or categorical as well as quantitative variables. The analysis is concerned with counts in multiway cross-classifications or multiway contingency tables. Multiway contingency tables, or cross-classifications of vectors of discrete random variables, provide a useful approach to the analysis of multivariate discrete data. The method of analysis presented will bring out the various inter-relationships among the classificatory variables in a multiway cross-classification or contingency table in many dimensions. The procedure is based on the Principle of Minimum Discrimination Information Estimation, associated statistics and Analysis of Information. General computer programs are available to provide the necessary results for inference. An analysis of a four-way contingency table is presented for illustration of these techniques. Author (GRA)

**N77-19806#** Brown Univ., Providence, R. I. R. I. Lefschetz Center for Dynamical Systems.
**CONTROL OF DYNAMICAL SYSTEMS Final Report, 1 Jun. 1975 - 31 May 1976**
J. P. LaSalle and E. F. Infante 30 Jul. 1976 57 p refs
(Grant AF-AFOSR-2078-71; AF Proj. 9769)
(AD-A031020; AFOSR-76-1088TR) Avail: NTIS HC A04/MF A01 CSCL 12/1

The problem of arbitrarily assigning closed loop poles of a linear multivariable system developed a new method, a generalization of the classical root locus method. Studies have also been conducted on the attainment to stable solutions of model matching problems. A technique was developed, based on a modified minimum energy regulator problem, to obtain feedback stabilization of linear time varying differential systems. Two methods of parameter identification for linear differential systems were developed. A study was made of bilinear control systems with applications to parachute gliding systems and the pursuit-evasion missile control problem. Studies were made of linear operator feedback for the compensation and control of multivariable systems. A number of computational methods and techniques for control problems with diffusion models were developed, in addition to the study of the application of Monte Carlo methods for the optimization of constrained noisy systems. The study of bifurcation problems has been pursued from the abstract viewpoint and for specific applications. Studies were continued for systems described by ordinary and functional differential equations. Author (GRA)

**N77-19807#** Texas A&M Univ., College Station. Dept. of Industrial Engineering.
**STATE-OF-THE-ART IN IMPROVED PARTS PROGRAMMING FOR NUMERICALLY CONTROLLED MACHINES Final Report**
M. J. Fox, Jr., R. E. Goforth, Donald L. Allen, and B. C. Bowers, Jr. Oct. 1976 113 p refs Revised
(Contract DAAG47-76-C-0024)
(AD-A030932) Avail: NTIS HC A06/MF A01 CSCL 13/8

This report discusses the state-of-the-art of numerical controlled manufacturing technology, as reflected by current literature and research. Standardization of machine languages and computer software are identified as areas of major importance. The incompatability of postprocessors was found to be a significant problem. The research of Bradford M. Smith in the standardization of postprocessors is identified as an important contribution to the efficient use of numerical controlled machine tools. Little research or literature on numerical controlled tooling, or its standardization, was located. Direct numerical control and computer numerical control are defined, and their impact on numerical control noted. An example of successful work exchange is cited, however, the lack of standardization of postprocessors is identified as a deterrent to effective work exchange. On line, interactive computer based information retrieval systems were used, and the results are reported. Author (GRA)

## 64 NUMERICAL ANALYSIS

Includes iteration, difference equations, and numerical approximation.

**N77-19808*#** Houston Univ., Tex. Dept. of Mathematics.
**THE ROLE OF EIGENVALUES IN LINEAR FEATURE SELECTION THEORY**
D. R. Brown and M. J. OMalley Dec. 1976 19 p refs
(Contract NAS9-15000)
(NASA-CR-151235; Rept-61) Avail: NTIS HC A02/MF A01 CSCL 12A

A particular measure of pattern class distinction called the average interclass divergence, or more simply, divergence, is considered. Here divergence will be the pairwise average of the expected interclass divergence derived from Hajek's two-class divergence. Author

**N77-19809#** California Univ., Berkeley. Lawrence Berkeley Lab.
**NUMERICAL SOLUTION OF BOLTZMANN'S EQUATION Ph.D. Thesis**
Gary Andrew Sod Apr. 1976 119 p refs
(Contract W-7405-eng-48)
(LBL-4662) Avail: NTIS HC A06/MF A01

The numerical solution of Boltzmann's equation is considered for a gas model consisting of rigid spheres by means of Hilbert's expansion. If only the first two terms of the expansion are retained, Boltzmann's equation reduces to the Boltzmann-Hilbert integral equation. Successive terms in the Hilbert expansion are obtained by solving the same integral equation with a different source term. The Boltzmann-Hilbert integral equation is solved by a new very fast numerical method. The success of the method rests upon the simultaneous use of four judiciously chosen expansions; Hilbert's expansion for the distribution function, another expansion of the distribution function in terms of Hermite polynomials, the expansion of the kernel in terms of the eigenvalues and eigenfunctions of the Hilbert operator, and an expansion involved in solving a system of linear equations through a singular value decomposition. The numerical method is applied to the study of the shock structure in one space dimension. Numerical results are presented for Mach numbers of 1.1 and 1.6. ERA

**N77-19810#** Sandia Labs., Albuquerque, N.Mex.
**QUALITY OF RUNGE-KUTTA FORMULAS**
Lawrence F. Shampine Jul. 1976 32 p refs
(Contract AT(29-1)-789)
(SAND-76-0370) Avail: NTIS HC A03/MF A01

Critical evaluation of mathematical software is essential for the designation of items worthy of general acceptance and for the production of improved software. In the case of codes to solve the initial-value problem for ordinary differential equations, the usual procedure is to compare performance on a set of test problems. The value of such comparisons hinges on the hypothesis that the performance in nearly all respects depends only on the behavior of the solutions, not the form of the equations themselves. Unfortunately, this not realistic for codes based on Runge-Kutta methods. Relative behavior is predicted on the average and applied to assessing the quality of Runge-Kutta formulas and their error estimators. This conceptual tool and other aspects of quality are illustrated in the generation of new formulas of high quality. 3 figures, 2 tables. ERA

**N77-19811#** Sandia Labs., Albuquerque, N.Mex.
**NUMERICAL AND COMPUTATIONAL ANALYSIS OF THE PARTIAL DIFFERENTIAL EQUATIONS IN HYDROCODES AND WAVECODES**
D. L. Hicks and R. T. Walsh Jun. 1976 141 p refs
(Contract AT(29-1)-789)
(SAND-75-0448) Avail: NTIS HC A07/MF A01

Discrete method for the solution of the partial differential equations arising in hydrocodes and wavecodes are presented in a tutorial fashion. By discrete methods is meant, for example, the methods of finite differences, finite elements, discretized characteristics, etc. The concepts of stability, consistency, convergence, order of accuracy, true accuracy, etc., and their relevance to the hydrocodes and wavecodes are discussed. ERA

**N77-19812#** Texas Univ., Austin. Center for Particle Theory.
**HYDRODYNAMICAL MODEL BASED ON A BAG-LIKE LAGRANGIAN**
C. B. Chiu, C. S. Lam (McGill Univ., Montreal), and K. H. Wang (McGill Univ., Montreal) Jun. 1976 15 p refs Sponsored in part by Natl. Res. Council of Can.
(Contract E(40-1)-3992)
(ORO-3992-275) Avail: NTIS HC A02/MF A01

Equations of motion of hydrodynamical model are derived from a gag-like Lagrangian by using the technique of information theory. Comments on the break-up of the system and on the properties of decay products are included. ERA

**N77-19813#** Los Alamos Scientific Lab., N.Mex.
**USE OF SYMBOLIC AND NUMERIC METHODS IN AN ALGORITHM FOR THE APPROXIMATION OF MULTIVARIATE FUNCTIONS**
David K. Kahaner and Mark B. Wells 1976 10 p refs Presented at ACM Symp. on Symbolic and Algebraic Computation, Yorktown Heights, N. Y., 10-12 Aug. 1976
(Contract W-7405-eng-36)
(LA-UR-76-541; Conf-760808-1) Avail: NTIS HC A02/MF A01

The calculation of a polynomial interpolant over a simplex for a given function of n variables is discussed. Polynomial manipulation is required for constructing these interpolants and matrix manipulation is necessary for evaluating them. Use of an extensible language in which various manipulations could easily be expressed greatly facilitated development of the general approximation algorithm of which this calculation is a part. ERA

**N77-19814#** Stanford Univ., Calif. Dept. of Statistics.
**PANELS AND TIME SERIES ANALYSIS: MARKOV CHAINS AND AUTOREGRESSIVE PROCESSES**
Theodore W. Anderson Jul. 1976 37 p refs
(Contract N00014-75-C-0442; NR Proj. 042-034)
(AD-A030653; SU-TR-24) Avail: NTIS HC A03/MF A01 CSCL 12/2

Statistical inference in two time series models is developed for cases where there are several observations on the entire time series. Emphasis is on first-order processes: the Markov chain for discrete data and the first-order autoregressive process for vectors of continuous variables. The models are not necessarily homogeneous (or stationary) in time. Sufficient statistics and maximum likelihood estimates are presented. (Continuous variables are assumed normally distributed.) Test criteria for various hypotheses are developed; on a large-sample basis these criteria have chi square-distributions. The close correspondence between properties and statistical methods for the two models is pointed out. GRA

**N77-19815#** Stanford Univ., Calif. Dept. of Operations Research.
**CONDITIONED LIMIT THEOREMS FOR SOME NULL RECURRENT MARKOV PROCESSES**
Richard Durrett Aug. 1976 84 p refs
(Contract N00014-76-C-0578; Grant NSF MCS-75-23607; NR Proj. 042-343)
(AD-A030652; SU-TR-39) Avail: NTIS HC A05/MF A01 CSCL 12/2

Let U sub k be a discrete time Markov process with state space E and let S be a proper subset of E. In several applications it is of interest to know the behavior of the system after a large number of steps given that the process has not entered S. for example if U sub k is a branching process a limit theorem of this type gives information about the size of the kth generation given that extinction has not occurred by time k. GRA

**N77-19816#** Wisconsin Univ., Madison. Mathematics Research Center.
**A METHOD FOR SOLVING BOUNDARY VALUE PROBLEMS AND SHELL THEORY WITHOUT ASSUMPTIONS Summary Report**
May 1976 36 p refs
(Contract DAAG29-75-C-0024)
(AD-A027896; MRC-TSR-1628) Avail: NTIS HC A03/MF A01 CSCL 20/11

A method is presented from which not only three-dimensional problems may be solved, but also two-dimensional theories can be explicitly deduced from three-dimensional equations of theory of elasticity without employing assumptions. The axially symmetric problem of hollow cylinders of any length is treated herein for illustrative purpose. However, the method can be applied to general cases, different geometric configurations and other similar problems in mathematical physics. The method yields true stresses including transverse shear and normal stresses and refined shell equations. GRA

**N77-19817#** Naval Ship Research and Development Center, Bethesda, Md.
**GEOCES: A GAUSSIAN ELIMINATION OUT-OF-CORE EQUATION SOLVER**
Donald A. Gignac Jun. 1976 30 p refs
(SR0140301)
(AD-A029484) Avail: NTIS HC A03/MF A01 CSCL 09/2

In the finite element approach to structural analysis the solution of the equation KU = P is basic. K is usually a banded matrix which is symmetric and positive definite. However in certain areas such as fluid-structures interaction problems K may be a non-symmetric banded matrix. Further the order of K is often so large that, even when the banded structure of K is taken into account, the storage of K in the core memory of a computer may not be feasible or even possible. GEOCES is a Gaussian elimination out-of-core equation solver for non-symmetric banded systems of linear equations. GEOCES should be regarded as experimental rather than as a production program. GEOCES is written in FORTRAN Extended for the CDC 6000 series of computers with respect to the SCOPE 3.4 operating system and assumes the availability of random access scratch files.
Author (GRA)

**N77-19818#** Stanford Univ., Calif. Dept. of Statistics.
**THE DISTRIBUTION OF CYCLE LENGTHS IN A CLASS OF ABSTRACT SYSTEMS**
Alan E. Gelfand and Crayton C. Walker 11 Aug. 1976 22 p refs
(Contract N00014-76-C-0475; NR Proj. 042-267)
(AD-A030696; SU-TR-236) Avail: NTIS HC A02/MF A01 CSCL 12/1

Systems which are built up from functionally identical elements having two inputs and two internal states are subjected to random initial positions and random structural connections such that a random determination of cycle length is achieved. This artifice enables tractable examination of the systems over varying system size. In particular a model is presented for the distribution of the cycle length variable and also the effect of system size on cycle length is considered. GRA

**N77-19819#** Carnegie-Mellon Univ., Pittsburgh, Pa. Dept. of Statistics.
**APPROXIMATE MAXIMUM LIKELIHOOD ESTIMATION OF A STEP FUNCTION SPECTRAL DENSITY**
Paul Shaman Jun. 1976 20 p refs
(Contract N00014-76-C-0930; Grant NSF MPS-75-08286; NR Proj. 042-367)
(AD-A031115; TR-115; ONR-2) Avail: NTIS HC A02/MF A01 CSCL 12/1

Approximate maximum likelihood estimates are obtained for the ordinates of a step function spectra density in the Gaussian case. The estimates are simply integral averages of the periodogram over the frequency bands in which the density is

constant. Whittle's form of the approximate likelihood is used. Results are given for scalar and vector processes. Author (GRA)

**N77-19820#** State Univ. of New York, Buffalo. Dept. of Computer Science.
**ON PERIODIC AND MULTIPLE AUTOREGRESSIONS**
Marcello Pagano Aug. 1976 24 p refs
(Contract N00014-72-C-0508; NR Proj. 042-234)
(AD-A030759; TR-14) Avail: NTIS HC A02/MF A01 CSCL 12/1

A methodology is presented for analyzing periodic autoregressions which is also applicable when inferring the second order properties of periodically correlated processes. In addition, capitalizing on the duality between periodic and multiple autoregressions, a method is set forth for analyzing the latter, which overcomes the usual requirements of a large number of both parameters and computer storage locations. Author (GRA)

**N77-19821#** State Univ. of New York, Buffalo. Statistical Science Div.
**ON THE STATIONARITY OF MULTIPLE AUTOREGRESSIVE APPROXIMANTS: THEORY AND ALGORITHMS**
H. Joseph Newton Aug. 1976 27 p refs
(Contract N00014-72-C-0508)
(AD-A030752; TR-43) Avail: NTIS HC A03/MF A01 CSCL 12/1

Numerical methods are presented for determining the stability of a multiple autoregressive scheme. The question of stability is important in prediction theory, but furthermore, the methods for determining stability are such that they yield information which is important when fitting time series models to data.
Author (GRA)

**N77-19822#** State Univ. of New York, Buffalo. Statistical Science Div.
**THE AUTOREGRESSIVE METHOD: A METHOD OF APPROXIMATING AND ESTIMATING POSITIVE FUNCTIONS**
Jean-Pierre Carmichael Aug. 1976 206 p refs
(Contract N00014-72-C-0508; NR Proj. 042-234)
(AD-A031122; TR-45) Avail: NTIS HC A10/MF A01 CSCL 12/1

The Fourier transform was considered for a positive function $f(\lambda)$ (or its sample Fourier transform) as a possibly complex covariance function of a hypothetical stationary complex-valued time series. This model time series by an autoregressive process of order p whose spectral density approximates (or estimates) the function $f(.)$. The equivalence of this interpretation with the theory of orthogonal polynomials on the unit circle was studied; also the consistency of the autoregressive estimator as p increases with the sample size. GRA

**N77-19823#** National Bureau of Standards, Washington, D.C.
**JOURNAL OF RESEARCH OF THE NATIONAL BUREAU OF STANDARDS: B: MATHEMATICAL SCIENCES, VOLUME 80B, NO. 1, JANUARY-MARCH 1976 Quarterly Report**
Mar. 1976 188 p
(PB-259620-01; JNBBAU-80B(01); LC-62-4414; QR-1) Avail: NTIS HC A09/MF A01 CSCL 12A

Non-negative sums of roots of unity; plane-wave scattering matrix theory of antennas and antenna-antenna interactions-formulation and application; optimal facility location for normally and exponentially distributed points; and real, 3 x 3, D-stable matrices were studied. Transient solutions for stratified fluid flows; equilvalence of partitioned matrices; as well as tables of binomial coefficients and Sterling numbers are presented. GRA

**N77-19111*#** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**SIMULATION OF TIME SERIES BY DISTORTED GAUSSIAN PROCESSES**
C. A. Greenhall *In its* The Deep Space Network 15 Feb. 1977 p 146-151 refs (For primary document see N77-19091 10-12)
Avail: NTIS HC A13/MF A01 CSCL 12A

# 65 STATISTICS AND PROBABILITY

Includes data sampling and smoothing; Monte Carlo method; and stochastic processes.

**N77-19824*#** Houston Univ., Tex.
**CHARACTERIZATIONS OF LINEAR SUFFICIENT STATISTICS**
B. C. Peters, Jr., Richard Redner, and Henry P. Decell, Jr. Aug. 1976 15 p refs
(Contract NAS9-15000)
(NASA-CR-151233; Rept-59) Avail: NTIS HC A02/MF A01 CSCL 12A

A necessary and sufficient condition is developed such that there exists a continous linear sufficient statistic T for a dominated collection of totally finite measures defined on the Borel field generated by the open sets of a Banach space X. In particular, corollary necessary and sufficient conditions are given so that there exists a rank K linear sufficient statistic T for any finite collection of probability measures having n-variate normal densities. In this case a simple calculation, involving only the population means and covariances, determines the smallest integer K for which there exists a rank K linear sufficient statistic T (as well as an associated statistic T itself). Author

**N77-19825*#** Houston Univ., Tex. Dept. of Mathematics.
**A STOCHASTIC APPROXIMATION ALGORITHM FOR ESTIMATING MIXTURE PROPORTIONS**
James Sparra Nov. 1976 7 p ref
(Contract NAS9-15000)
(NASA-CR-151234; Rept-60) Avail: NTIS HC A02/MF A01 CSCL 12A

A stochastic approximation algorithm for estimating the proportions in a mixture of normal densities is presented. The algorithm is shown to converge to the true proportions in the case of a mixture of two normal densities. Author

**N77-19826#** Stanford Univ., Calif. Dept. of Statistics.
**ON COMBINING PSEUDORANDOM NUMBER GENERATORS**
Mark Brown and Herbert Solomon 15 Jul. 1976 11 p refs
(Contract N00014-76-C-0475; NR Proj. 042-267)
(AD-A030693; TR-233) Avail: NTIS HC A02/MF A01 CSCL 09/2

Let X = (X1,...,Xn) and Y = (Y1,...,Yn) be independent random vectors whose components take values in (0,1,...,m-1). Let r be the joint distribution of n independent random variables uniformly distributed on (0,1,...,m-1). It is shown that the distribution of Z = X + Y (mod m) is closer to r, in several metrics, than is either the distribution of X or of Y. The principle suggested by this result is that combining strings of pseudorandom numbers, generated by different generators, by addition mod m, will result in a string more random than any of the separate strings.
Author

**N77-19827#** Stanford Univ., Calif. Dept. of Operations Research.
**CONDITIONED LIMIT THEOREMS IN QUEUEING THEORY**
Peichuen Kao Jul. 1976 72 p refs
(Contract N00014-76-C-0578; Grant NSF MCS-75-23607; NR Proj. 042-343)
(AD-A030651; SU-TR-38) Avail: NTIS HC A04/MF A01 CSCL 12/2

In this dissertation stochastic processes are studied which arise out of a single G1/G/1 queueing system. Concern here is with the weak convergence of each process conditioned on an event whose probability is converging to zero as time becomes large. GRA

**N77-19828#** Control Analysis Corp., Palo Alto, Calif.
**VARIANCE REDUCTION FOR REGENERATIVE SIMULATIONS. 1: INTERNAL CONTROL AND STRATIFIED SAMPLING FOR QUEUES**
Donald L. Iglehart (Stanford Univ., Calif.) and Peter A. W. Lewis (Naval Postgraduate School) Aug. 1976 35 p refs
(Contract N00014-72-C-0086; NR Proj. 047-106)
(AD-A030842; TR-86-22) Avail: NTIS HC A03/MF A01 CSCL 12/2

Two methods are discussed for reducing the variance of estimators of parameters of limiting distributions of stable stochastic processes in simulations. The methods are discussed in the context of the simple GI/G/1 queue. Of the two methods one, which is called an internal control variable, gives a variance reduction which is roughly uniform over values of the parameters of the process and, in particular, works well for values of rho sub 1 the traffic intensity, close to 1. GRA

**N77-19829#** Stanford Univ., Calif. Dept. of Statistics.
**DISCRIMINATION, ALLOCATORY AND SEPARATORY, LINEAR ASPECTS**
Seymour Geisser 9 Sep. 1976 39 p refs
(Contract N00014-76-C-0475; NR Proj. 042-267)
(AD-A030698; SU-TR-238) Avail: NTIS HC A03/MF A01 CSCL 12/1

This paper delineates two distinct purposes of discriminatory analyses--allocation and separation--and examines the linear aspects involved. After a review of multivariate normality and a discussion of the extent to which linearity is optimal, suggestions are made as to the actual use of linear discriminants. Then, dropping distributional assumptions, we focus on the separation of populations via linear functions. We also discuss the application of sample reuse procedures to linear discriminants. Author (GRA)

**N77-19830#** Stanford Univ., Calif. Dept. of Statistics.
**SPEARMAN'S FOOTRULE AS A MEASURE OF DISARRAY**
Persi Diaconis and R. L. Graham 2 Sep. 1976 19 p refs
(Contract N00014-76-C-0475; NR Proj. 042-267; Grant NSF MPS-74-21416)
(AD-A030697; SU-TR-237; NSF-TR-88) Avail: NTIS HC A02/MF A01 CSCL 12/1

Spearman's rho and Kendall tau are related to two less widely used measures of association: Spearman's footrule and the minimum number of transitions. The means, variances, and limiting normality of all four metrics are derived. GRA

**N77-19831#** Stanford Univ., Calif. Dept. of Statistics.
**TOTAL PROGENCY IN A CRITICAL AGE-DEPENDENT BRANCHING PROCESS WITH IMMIGRATION**
Howard Weiner 22 Jul. 1976 18 p refs
(Contract N00014-76-C-0475; NR Proj. 042-267)
(AD-A030694; SU-TR-234) Avail: NTIS A02/MF A01 CSCL 12/1

Let Z(t) = total number of cells born by t to critical age-dependent branching processes initiated by immigration at renewal epochs, with a random number of new cells introduced at each epoch, and where the mean cell lifetime is unequal to that of the mean time between immigration epochs. By extending a result for the discrete-time case of Pakes, and using approximation techniques and a rate of convergence result for a generalized law of large numbers, it is shown that, using second moments that the limit of E as t approaches infinity for exp(- theta t square z(t)) exists, and is explicitly given. GRA

**N77-19832#** Stanford Univ., Calif. Dept. of Statistics.
**REPEATED MEASUREMENTS ON AUTOREGRESSIVE PROCESSES**
Theodore W. Anderson Sep. 1976 45 p refs
(Contract N00014-75-C-0442; NR Proj. 042-034)
(AD-A030654; SU-TR-25) Avail: NTIS HC A03/MF A01 CSCL 12/1

Estimation of parameters and tests of hypotheses are studied in first-order autoregressive processes where the process is observed several times over a given time interval. The process may be homogeneous (that is, the parameters may be constant over time) or inhomogeneous (time-varying parameters). Sufficient statistics under normality are obtained for various cases and several tests of hypotheses are given. Author (GRA)

**N77-19833#** Carnegie-Mellon Univ., Pittsburgh, Pa. Dept. of Statistics.
**MAXIMUM LIKELIHOOD ESTIMATION OF STOCHASTIC LINEAR DIFFERENCE EQUATIONS WITH AUTOREGRESSIVE MOVING AVERAGE ERRORS**
Greg Reinsel Jun. 1976 37 p refs
(Contract N00014-76-C-0930; NR Proj. 042-367)
(AD-A031127; TR-112; ONR-1) Avail: NTIS HC A03/MF A01 CSCL 12/1

A method is proposed for the estimation of a general class of scalar linear time series models. The model takes the form of a stochastic difference equation for the dependent variable with exogenous variable inputs, and the disturbances are autocorrelated through an autoregressive moving average process. In the present paper an asymptotically efficient yet computationally simple estimation procedure (in the time domain) is derived for this model. The resulting estimator is shown to be asymptotically equivalent to the maximum likelihood estimator and to possess a limiting multivariate normal distribution. Author (GRA)

**N77-19834#** Case Western Reserve Univ., Cleveland, Ohio. Dept. of Mathematics and Statistics.
**THE APPLICATION OF STOCHASTIC APPROXIMATION METHODS TO THE BIO-ASSAY PROBLEM**
Dan Anbar 2 Aug. 1976 21 p refs
(Contract N00014-75-C-0529; NR Proj. 042-276)
(AD-A031054; TR-25) Avail: NTIS HC A02/MF A01 CSCL 12/1

A new general model for the bio-assay problem is introduced. It is shown that when the slope of the dose-response curve and the median effective dose is known, the Robbins-Monro method yields an asymptotically optimal estimation procedure. Adaptive procedures are discussed for the case of unknown slope. Results of Monte Carlo studies are given. Author (GRA)

**N77-19835#** Cornell Univ., Ithaca, N.Y. School of Operations Research and Industrial Engineering.
**GOODNESS OF FIT TESTS FOR COMPOSITE HYPOTHESES BASED ON AN INCREASING NUMBER OF ORDER STATISTICS**
Ray Hamilton Jakobovits Sep. 1976 167 p refs
(Contracts DAHC04-73-C-0008; N00014-75-C-0586; Grant NSF MCS-76-06340)
(AD-A030790; TR-310) Avail: NTIS HC A08/MF A01 CSCL 12/1

Concern is shown with sequences of tests of the composite null hypothesis that the distribution function of an observed sample is a member of a specified scale-location parameter family, where the scale and location parameters are unknown and unspecified. First, a test of this hypothesis proposed by L. Weiss is studied. Then several tests for the most common special case--that of normality are analyzed. GRA

**N77-19836#** Pennsylvania State Univ., University Park. Coll. of Business Administration.
**A PROBABILISTIC EXPECTED UTILITY THEORY OF RISKY BINARY CHOICES Interim Report**
Peter C. Fishburn Sep. 1976 28 p refs
(Contract N00014-75-C-0857; NR Proj. 047-112)
(AD-A031219; TR-23) Avail: NTIS HC A03/MF A01 CSCL 12/2

Let P be a real function on pairs of gambles with quantitative outcomes, with P(p,q) interpreted as the probability that an individual will choose gamble p over q when required to make a choice between the two. Assuming that outcome x is preferred to y when x = y, an incremental expected utility advantage model is defined for P. This model is based on an underlying Von Neumann-Morgenstern utility function on outcomes and on interdependent aspects of pairs of gambles. It can be viewed as a modified expected utility model that accounts for probabilistic choice behavior. Eight axioms for P are shown to be necessary and sufficient for the incremental expected utility advantage model. GRA

**N77-19837#** Texas A&M Univ., College Station.
**A SUPER-POPULATION APPROACH TO MULTI-STAGE SAMPLING**
R. K. Burdick, H. O. Hartley, L. J. Ringer, and R. L. Sielken, Jr. Aug. 1976 94 p refs
(Contract DAHC04-74-C-0018)
(AD-A031072; TR-17; ARO-8049.16-M) Avail: NTIS HC A05/MF A01 CSCL 12/1

This report develops a new technique for the estimation of finite population parameters in a multi-stage sample survey.

Specifically, estimators and confidence intervals for parameters of the finite population are developed for two-stage sampling when primaries are of either equal or unequal size, two-stage sampling when the variable of interest, y, is related to another variable, x, and p-stage sampling with an example of three-stage sampling when units are of equal size. The stochastic procedure generating the sample is assumed to be a two step procedure where the first step is selection of a 'large sample' from an infinite superpopulation and the second step is the actual implementation of the sample survey. Author (GRA)

# 66 SYSTEMS ANALYSIS

Includes mathematical modeling; network analysis; and operations research.

**N77-19838#** Stanford Univ., Calif. Dept. of Operations Research.

**OPTIMAL CONTROL OF THE M/G/1 QUEUEING SYSTEM WITH REMOVABLE SERVER-LINEAR AND NON-LINEAR HOLDING COST FUNCTION**

Peter Orkenyi Aug. 1976 100 p refs

(Contract N00014-76-C-0418; Grant NSF ENG-75-14847; NR Proj. 047-061)

(AD-A030646; SU-TR-65) Avail: NTIS HC A05/MF A01 CSCL 12/2

This report considers the M/G/1 queueing system with removable server. The cases of linear and non-linear customer holding cost functions are both considered. Non-instantaneous start-up times are allowed. The problem is to find an optimal policy for turning the server on and off. The optimality criteria considered are the average cost criterion, the undiscounted cost criterion and the discounted cost criterion. A certain class of simple policies, the hysteretic policies, is considered. Natural hysteretic policies and non-degenerate hysteretic policies are introduced. It is shown that there is a natural hysteretic policy which is average optimal, and that if the start-up times are instantaneous or the holding cost function convex, then there is a natural hysteretic policy which is undiscounted optimal. When discounting is used, the results are not as strong, except for the case where the holding cost function is linear. For the non-linear case we still obtain certain fairly weak sufficient conditions for a natural hysteretic policy to be optimal.

Author (GRA)

**N77-19839#** Carnegie-Mellon Univ., Pittsburgh, Pa. Dept. of Statistics.

**MAXIMUM LIKELIHOOD ESTIMATION OF VECTOR AUTOREGRESSIVE MOVING AVERAGE MODELS**

Greg Reinsel Jul. 1976 26 p refs

(Contract N00014-76-C-0930; NR Proj. 042-367)

(AD-A031116; TR-117; ONR-3) Avail: NTIS HC A02/MF A01 CSCL 12/2

A method is presented for the estimation of the parameters in the vector autoregressive moving average time series model. The estimation procedure is derived from the maximum likelihood approach and is based on Newton-Raphson techniques applied to the likelihood equations. The resulting two-step Newton-Raphson procedure is computationally simple, involving only generalized least squares estimation in the second step. This Newton-Raphson estimator is shown to be asymptotically efficient and to possess a limiting multivariate normal distribution.

Author (GRA)

# 67 THEORETICAL MATHEMATICS

Includes topology and number theory.

No abstracts in this category.

# 70 PHYSICS (GENERAL)

For geophysics see *46 Geophysics*. For astrophysics see *90 Astrophysics*. For solar physics see *92 Solar physics*.

**N77-19840#** Atomic Energy Research Establishment, Harwell (England).

**VAPOR EXPLOSIONS (FUEL-COOLANT INTERACTIONS) RESULTING FROM THE SUB-SURFACE INJECTION OF WATER INTO MOLTEN METALS: PRELIMINARY RESULTS**

R. C. Asher, D. Bullen, and D. Davies Mar. 1976 14 p refs (AERE-M-2772) Avail: NTIS (US Sales Only) HC A02/MF A01; ERDA Depository Libraries

Preliminary experiments are reported on the relationship between the injection mode of contact and the occurrence and magnitude of vapor explosions. Water was injected beneath the surface of molten metals, chiefly tin at 250 to 900 C. Vapor explosions occurred in many, but not all, cases. The results are compared with Dullforce's observations on the dropping mode of contact and it appears that rather different behavior is found; in particular, the present results suggest that the temperature interaction zone is different for the two modes of contact. ERA

**N77-19841#** Centre National d'Etudes Spatiales, Toulouse (France).

**MEASUREMENT OF RELATIVISTIC SHIFT BETWEEN A SPACEBORNE CLOCK AND A CLOCK ON EARTH. PROVISIONAL ERROR ANALYSIS [MESURE DU DECALAGE RELATIVISTE ENTRE UNE HORLOGE EMBARQUEE A BORD D'UN ENGIN SPATIAL ET UNE HORLOGE TERRESTRE, BILAN PREVISIONNEL DES ERREURS]**

Alain Blanchard Oct. 1976 37 p refs In FRENCH; ENGLISH summary

(CNES-NT-51) Avail: NTIS HC A03/MF A01

A first analysis is presented of the errors due to relativity theory and occurring in frequency difference measurements between a high stability clock on-board a spacecraft and a similar one based on earth. Numerical calculations are carried out for the case of a geosynchronous transfer orbit. Author (ESA)

# 71 ACOUSTICS

Includes sound generation, transmission and attenuation.

For noise pollution see *45 Environment Pollution*.

**N77-18996#** Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Berlin (West Germany). Institut fuer Turbulenzforschung.

**BASIC AERODYNAMIC NOISE THEORY**

Helmut V. Fuchs *In* AGARD Aerodynamic Noise, Jan. 1977 26 p refs (For primary document see N77-18994 10-01)

Avail: NTIS HC A14/MF A01

**N77-19000*#** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

**AIRPLANE SELF-NOISE - FOUR YEARS OF RESEARCH**

Jay C. Hardin *In* AGARD Aerodynamic Noise, Jan. 1977 19 p refs (For primary document see N77-18994 10-01)

Avail: NTIS HC A14/MF A01

**N77-19001#** Southampton Univ. (England). Institute for Sound and Vibration Research.

**AERO-ACOUSTIC MEASUREMENT AND ANALYSIS TECHNIQUES**

Michael E. House *In* AGARD Aerodynamic Noise, Jan. 1977 48 p refs (For primary document see N77-18994 10-01)

Avail: NTIS HC A14/MF A01

# 72 ATOMIC AND MOLECULAR PHYSICS

Includes atomic structure and molecular spectra.

**N77-19842*#** Old Dominion Univ. Research Foundation, Norfolk, Va.

**COMPUTER PROGRAM TO SIMULATE RAMAN SCATTERING Final Report, 26 Feb. 1975 - 31 Oct. 1976**

Barbara Zilles and Roscoe Carter Mar. 1977 62 p refs (Contract NAS1-13820)

(NASA-CR-145151) Avail: NTIS HC A04/MF A01 CSCL 20M

A computer program is described for simulating the vibration-rotation and pure rotational spectrum of a combustion system consisting of various diatomic molecules and CO2 as a function of temperature and number density. Two kinds of spectra are generated: a pure rotational spectrum for any mixture of diatomic and linear triatomic molecules, and a vibrational spectrum for diatomic molecules. The program is designed to accept independent rotational and vibrational temperatures for each molecule, as well as number densities. Author

**N77-19843*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

**TOTAL BORN APPROXIMATION CROSS SECTIONS FOR SINGLE ELECTRON LOSS BY ATOMS AND IONS COLLIDING WITH ATOMS**

Donald W. Ruie (NAS-NRC) Feb. 1977 30 p refs Submitted for publication

(NASA-TM-X-71279; X-602-77-39) Avail: NTIS HC A03/MF A01 CSCL 20H

The first born approximation (FBA) is applied to the calculation of single electron loss cross sections for various ions and atoms containing from one to seven electrons. Screened hydrogenic wave functions were used for the states of the electron ejected from the projectile, and Hartree-Fock elastic and incoherent scattering factors were used to describe the target. The effect of the target atom on the scaling of projectile ionization cross sections with respect to the projectile nuclear charge was explored in the case of hydrogen-like ions. Scaling of the cross section with respect to the target nuclear charge for electron loss by Fe (+25) in collision with neutral atoms ranging from H to Fe is also examined. These results were compared to those of the binary encounter approximation and to the FBA for the case of ionization by completely stripped target ions. Author

**N77-19844#** California Univ., Berkeley. Lawrence Berkeley Lab.

**ELECTRON-CORRELATION SATELLITES IN ELECTRON SPECTROSCOPY**

D. A. Shirley, R. L. Martin, B. E. Mills, S. Suzer, S. T. Lee, E. Matthias, and R. A. Rosenberg Mar. 1976 20 p refs Presented at 2d Intern. Conf. on Inner-shell Ionization Phenomena, Freiberg, 29 Mar. 1976

(Contract W-7405-eng-48)

(LBL-4951; Conf-760326-3) Avail: NTIS HC A02/MF A01

Electron-correlation satellites in ion and atom emission spectra are reviewed. The topics developed are the early history using Mn(2+) as an example, shake-up satellites and initial-state-configuration interaction (ISCI), direct observation of ISCI by photoemission. ERA

**N77-19845#** Brookhaven National Lab., Upton, N.Y.

**INVESTIGATIONS INTO THE THERMAL DEFECT OF TISSUE-EQUIVALENT PLASTIC**

Leon J. Goodman and J. C. McDonald (Memorial-Sloan-Kettering Cancer Center, New York) 1976 3 p refs Neutron Dosimetry Workshop, Rijswijk, Netherlands, 19 May 1976 Prepared in cooperation with Columbia Univ., N. Y.

(Contracts E(11-1)-3243; E(30-1)-16; E(11-1)-3522; Grant CA-12536)

(BNL-21208; Conf-760533-1) Avail: NTIS HC A02/MF A01

The thermal defect, defined as the fraction of absorbed radiation energy which is not converted to heat energy in the calorimetric dosimetry absorber was investigated for A-150 tissue-equivalent plastic. It is proposed to measure the thermal defect as a function of proton energy and for various energies of alpha particles and it is proposed the heavy recoil nuclei produced in tissue by neutrons. Comparison of the thermal defects of A-150 plastic obtained from different laboratories and molded under diverse conditions is also suggested. ERA

**N77-19846#** California Univ., Livermore. Lawrence Livermore Lab.

**HIGH-INTENSITY, SUBKILOVOLT X-RAY CALIBRATION FACILITY**

R. W. Kuckuck, J. L. Gaines, and R. D. Ernst 6 May 1976 8 p refs Presented at ERDA Symp. on X- and Gamma-ray Sources Appl., Ann Arbor, Mich., 19-21 May 1976

(Contract W-7405-eng-48)

(UCRL-78186; Conf-760539-1) Avail: NTIS HC A02/MF A01

A high-intensity subkilovolt X-ray calibration source utilizing proton-induced inner-shell atomic fluorescence of low-Z elements is described. The high photon yields and low bremsstrahlung background associated with this phenomenon are ideally suited to provide intense, nearly monoenergetic X-ray beams. The proton accelerator is a 3 mA, 300 kV Cockroft-Walton using a conventional RF hydrogen ion source. Seven remotely-selectable targets capable of heat dissipation of 5 kW/sq cm are used to provide characteristic X-rays with energies between 100 and 1,000 eV. Methods of reducing spectral contamination due to hydrocarbon build-up on the target are discussed. Typical X-ray spectra (Cu-L, C-K and B-K) are shown. ERA

**N77-19847#** Argonne National Lab., Ill.

**THEORY OF IONIZATION BY ELECTRON COLLISIONS**

U. Fano Jun. 1976 47 p refs

(Contract W-31-109-eng-38)

(ANL-76-80) Avail: NTIS HC A03/MF A01

The problem of calculating comprehensive sets of cross sections for ionization of atoms and molecules is reviewed. Emphasis is put on targets that are already ionized and lower-energy collisions for which the incident electron must be discussed in which perturbation methods should be adequate, and special investigations are recommended to identify the relevant ranges of parameters more precisely and dependably. A new R-matrix approach is outlined which should permit rather simple, approximate, but dependable calculations when the perturbation methods fail. ERA

**N77-19848#** Carnegie-Mellon Univ., Pittsburgh, Pa.

**GENERALIZED OSCILLATOR STRENGTHS Technical Progress Report, 1 Jan. 1970 - 1 Jul. 1976**

Edwin N. Lassettre 1976 74 p refs

(Contract E(11-1)-3247)

(COO-3247-34) Avail: NTIS HC A04/MF A01

The status of methods for the experimental determination of electron collision cross sections and generalized oscillator strengths is discussed including the comparison of inelastic and elastic scattering when elastic cross sections are available, the use of a comparison gas with a transition of known cross section, and the determination of optical oscillator strengths from forward scattering spectra. Discrepancies between limiting generalized oscillator strengths (at zero momentum change) and optical oscillator strengths are resolved for the most part. Two new selection rules, one relating to single - singlet transitions, the other to singlet-triplet transitions are described. Deviations from the Born Approximation at large momentum changes are discussed. Generalized oscillator strengths are applied to the calculation of cross sections for resonant energy transfer in collision between two molecules one of which is excited. ERA

**N77-19849#** Naval Research Lab., Washington, D.C.

**COMPUTER CODE FOR THE CALCULATION OF LATERAL RANGE OF A PKA**

I. Manning, M. Rosen, and J. E. Westmoreland Sep. 1976 18 p refs

(NRL Proj. H01-67; RR0210302)

(AD-A030633; NRL-MR-3358) Avail: NTIS HC A02/MF A01 CSCL 09/2

The Naval Research Laboratory energy deposition code E-DEP-1 has been adapted to calculate lateral ranges. The revised code, which is capable of handling incident energies varying

from 1 keV to 50 MeV, retains the convenience and economy of the previous code. The accuracy in the lateral ranges calculated is shown to be of the order of 15% for the case where the mass ratio of incident to target atoms is close to 1 and is much greater when this ratio differs significantly from unity. GRA

**N77-19850#** Naval Research Lab., Washington, D.C. Plasma Physics Div.
**RIGID ROTOR EQUILIBRIUM OF A STRONG ION LAYER**
C. A. Kapetanakos, J. Golden, and D. R. Chu (Sci. Appl, Inc., McLean, Va.) Sep. 1976 25 p refs
(NRL Proj. H02-28A)
(AD-A031169; NRL-MR-3370) Avail: NTIS HC A02/MF A01 CSCL 20/8

The equilibrium properties of a strong, space charge neutral ion layer that is confined radially by an externally applied magnetic field are examined within the framework of the steady-state Vlasov-Maxwell equations. The selected distribution function not only allows radial confinement of the gyrating protons, but also is simple enough that explicit, analytic expressions can be obtained for the particle density, current density, magnetic field and the radii of the p-layer, without any a priori assumption about the radial dimensions of the layer. When the ion density is high, thin layer equilibria exist only for small rotational velocities, and for a small range of the conducting wall radius, the frequency of rotation can be considerably greater than the cyclotron frequency corresponding to the externally applied magnetic field. Author (GRA)

**N77-19851#** Rockwell International Science Center, Thousand Oaks, Calif.
**ANALYTICAL APPLICATIONS OF ELECTRON SPIN RESONANCE Technical Report, 1 Jan. - 30 Sep. 1976**
Ira B. Goldberg Sep. 1976 113 p refs
(Contract N00014-73-C-0325; NR Proj. 051-553)
(AD-A031078; SC549.19TR; TR-7) Avail: NTIS HC A06/MF A01 CSCL 07/4

This report reviews applications of electron spin resonance (ESR) to chemical analysis. Basic theory of ESR and the instrumentation required for chemical analysis is discussed. The theory of ESR absorption is presented for the general case, and simplified forms for specific conditions are derived. These are applicable to solid, liquid and gas phase analysis of paramagnetic materials. Finally, specific techniques which utilize ESR are described. The application of the computer for calculation of the double integral of the ESR lineshape and suggestions for optimizing accuracy of the determinations are presented. Author (GRA)

**N77-19852#** Yale Univ., New Haven, Conn. Dept. of Engineering and Applied Science.
**CHEMICAL REACTIVITY AND MOLECULAR BEAM SCATTERING Final Report, 1 Feb. 1972 - 31 Mar. 1976**
J. B. Fenn, T. Nenner, H. Tien, and P. J. Gale Jul. 1976 42 p refs
(Grant AF-AFOSR-2236-72; AF Proj. 9538; AF Proj. 6813)
(AD-A030889; AFOSR-76-1084TR) Avail: NTIS HC A03/MF A01 CSCL 07/4

The research program detailed in this final report concerns the measurement of integral cross sections for a large number of molecules. From such cross sections it is possible to determine the so-called Van Der Waals or C6 coefficients for the attractive portion of the pair-wise potentials, which follow a $1/r$ raised to 6th power dependence on the inter-particle distance. The authors obtained absolute values for total scattering cross sections at velocities well-defined for each of 38 different systems involving Ar and a variety of target molecules, chiefly hydrocarbons. From these scattering cross sections C6 values for each system were deduced. Using the values of these coefficients obtained from our cross section measurements, they were also able to test a mixing rule recommended by Kramer and Herschbach which allows estimation of force constants between unlike molecules from their interaction with a common partner. They have evaluated the method as a predictive tool for the estimation of transport and thermodynamic properties which depend upon the attractive forces between molecules. GRA

**N77-19853#** Joint Inst. for Lab. Astrophysics, Boulder, Colo.
**MOMENT-THEORY INVESTIGATIONS OF PHOTOABSORPTION AND DISPERSION PROFILES IN ATOMS AND IONS Final Report**
P. W. Langhoff, J. S. Corcoran (Indiana Univ., Bloomington), F. Sims (Indiana Univ., Bloomington), F. Weinhold (Stanford Univ., Calif.), and R. M. Glover (Stanford Univ., Calif.) 11 Mar. 1976 17 p refs Repr. from Phys. Rev., A (US), v. 14, no. 3, Sept. 1976 p 1042-1056 Supported in part by American Chemical Society
(PB-258573/5) Avail: NTIS HC A01/MF A02 CSCL 07D

An improved (Tchebycheff) moment approach is introduced which gives profiles that are continuous in the photoionization region and exhibit the delta-function-like behavior associated with discrete transitions at the appropriate frequencies. The methods are applied in illustrative calculations of absorption and dispersion profiles in one- and two-electron atoms and ions. In the case of one-electron atomic systems the necessary polynomial recurrence coefficients are obtained in closed form from the known spectral moments. Variational calculations using large basis sets of square-integrable functions provide accurate spectra moments for atomic helium and the negative hydrogen ion. GRA

# 73 NUCLEAR AND HIGH-ENERGY PHYSICS

Includes elementary and nuclear particles; and reactor theory.

For space radiation see *93 Space Radiation.*

**N77-19854#** Brandeis Univ., Waltham, Mass. Dept. of Physics.
**RESEARCH IN ELEMENTARY PARTICLE PHYSICS Progress Report, 31 May 1975 - 29 May 1976**
Lawrence Kirsch and Howard J. Schnitzer 1976 15 p
(Contract E(11-1)-3230)
(COO-3230-5) Avail: NTIS HC A02/MF A01

Theoretical and experimental research on high energy physics is summarized. A list of publications is included. ERA

**N77-19855#** Argonne National Lab., Ill.
**FUTURE UTILIZATION OF POLARIZED BEAMS AND TARGETS AT THE ZGS: REPORT OF THE TECHNICAL ADVISORY PANEL**
Apr. 1976 34 p refs Sponsored by ERDA
(ANL-HEP-CP-76-18) Avail: NTIS HC A03/MF A01

A program is proposed for upgrading the usefulness and attractiveness of ZGS polarized facilities to the user community. Recommendations are summarized, and a discussion is given of past activities and future plans of various experimental groups and ZGS facilities. A series of arguments is made concerning possible future experiments, suggested or proposed. ERA

**N77-19856#** Royal Inst. of Tech., Stockholm (Sweden). Dept. of Electron Physics.
**A DESIGN STUDY OF A 100 MeV RACE-TRACK MICROTRON/PULSE-STRETCHER ACCELERATOR SYSTEM**
R. Alvinsson and Mikael Eriksson (Lund Univ.) Apr. 1976 84 p refs
(TRITA-EPP-76-07; LUSY-7601) Avail: NTIS HC A05/MF A01

A proposed design of an accelerator system with large duty-factor is described. The system is composed of a race-track microtron and a pulse-stretcher. The maximum particle energy is 100 MeV and the beam current is estimated to be up to 10 micro A within + or - 100 keV. The intended use is mainly for nuclear physics experiments with high precision, where the combination of large mean current and limited pulse intensity is essential. Author (ESA)

# 74 OPTICS

Includes light phenomena.

**N77-19857#** National Oceanic and Atmospheric Administration, Honolulu, Hawaii. Joint Tsunami Research Effort.
**HYDROLOGIC OPTICS. VOLUME 1: INTRODUCTION**
R. W. Preisendorfer 1976 254 p refs 6 Vol.
(PB-259793/8; NOAA-76082307-Vol-1) Avail: NTIS HC A12/MF A01 CSCL 20F

Particular attention is directed toward the three simple models for light fields in natural waters. These models constitute the minimal theoretical tools for the field of hydrologic optics. Attention is also directed to the section dealing with practical nomographs for predicting the range of visibility available to underwater swimmers in various natural hydrosols such as harbors, lakes, and seas. Also of general interest are the many samples of magnitudes of light fields and optical constants found in natural waters. Radiometric concepts and formulations needed in the applications of the interaction principle to hydrologic optics are included. GRA

DATA SUMMARY: Diverse data are presented; variables include illumination, wavelength, altitude, air-water surface, rough surface, smooth surface, reflectance, irradiance distribution, zenith angle, and depth.

**N77-19858#** National Oceanic and Atmospheric Administration, Honolulu, Hawaii. Joint Tsunami Research Effort.
**HYDROLOGIC OPTICS. VOLUME 2: FOUNDATIONS**
R. W. Preisendorfer 1976 411 p refs 6 Vol.
(PB-259794/6; NOAA-76082308-Vol-2) Avail: NTIS HC A18/MF A01 CSCL 20F

The concepts of radiometry and photometry needed in the study of radiative theory are discussed along with the interaction principle. Specific topics considered include: (1) radiant flux; (2) the meaning and fundamental geometric properties of radiant flux; (3) irradiance and radiant emittance; (4) polarized radiance; (5) reflectance and transmittance operators for surfaces; and (6) interaction operators for general spaces. GRA

DATA SUMMARY: Sky (field) radiance distribution; variables include sun's azimuth, wavelength, luminosity, environment, and magnitude of irradiance; 2 figures and 4 tables include numeric data.

**N77-19859#** National Oceanic and Atmospheric Administration, Honolulu, Hawaii. Joint Tsunami Research Effort.
**HYDROLOGIC OPTICS. VOLUME 3: SOLUTIONS**
R. W. Preisendorfer 1976 255 p refs 6 Vol.
(PB-259795/3; NOAA-76082309-Vol-3) Avail: NTIS HC A12/MF A01 CSCL 20F

The theory of light fields and solutions of the equation of transfer are reviewed. Specific topics covered include: (1) radiance in transparent media; (2) the general canonical equation for radiance; (3) the canonical representation of polarized radiance; (4) the n-ary radiance, diffuse radiance, and path function; (5) the transport equation for residual, directly observable, and n-ary radiant energy; (6) properties of time dependent n-ary radiant energy fields; and (7) approaches to diffusion theory and solutions of the classical and exact diffusion equations. GRA

DATA SUMMARY: Diverse data are presented; variables include diffusion processes, scattered radiant energy, residual radiant energy, attenuation time constant, and scattering attenuation ratio.

**N77-19860#** National Oceanic and Atmospheric Administration, Honolulu, Hawaii. Joint Tsunami Research Effort.
**HYDROLOGIC OPTICS. VOLUME 4: IMBEDDINGS**
R. W. Preisendorfer 1976 216 p refs 6 Vol.
(PB-259796/1; NOAA-76082310-Vol-4) Avail: NTIS HC A10/MF A01 CSCL 20F

Invariant imbedding techniques for light fields are examined. Subjects presented are: differential equations governing the steady state R and T operators; differential equations governing the time dependent R and T operators; algebraic properties of the invariant imbedding operators; analytic properties of the invariant imbedding operators; special solution procedures for R(a,b) and T(a,b) in plane-parallel media; method of semigroups for deep homogeneous media; method of groups for deep homogeneous media; method of groups for general optical media; and invariant imbedding and integral transform techniques. GRA

DATA SUMMARY: No numeric data are presented.

**N77-19861#** National Oceanic and Atmospheric Administration, Honolulu, Hawaii. Joint Tsunami Research Effort.
**HYDROLOGIC OPTICS. VOLUME 5: PROPERTIES**
R. W. Preisendorfer 1976 304 p refs 6 Vol.
(PB-259797/9; NOAA-76082311-Vol-5) Avail: NTIS HC A14/MF A01 CSCL 20F

Major emphasis is on the optical properties of the sea that govern the penetration of natural light into its depths. The stratified light field, so prevalent in oceanography and limnology is studied and the special and interesting behavior of the light field and its attendant apparent optical properties at both small and great depths in the sea are explored in detail. Subjects treated are: models for irradiance fields; general theory of optical properties; optical properties at extrene depths; and the universal radiative transport equation. GRA

DATA SUMMARY: Depth dependence of attenuation functions; variables include depth, shape, radiance distribution functions, clear sunny day, and overcast day 1 table includes numeric data.

**N77-19862#** IIT Research Inst., Chicago, Ill.
**OPTICAL COUPLERS FOR FIBER TO INTEGRATED OPTICS SYSTEMS Final Report, 1 Jun. 1975 - 1 Jun. 1976**
Ronald L. Ohlhaber 30 Jul. 1976 34 p
(Contract N00014-75-C-1159; NR Proj. 288-011)
(AD-A030184; IITRI-E6332) Avail: NTIS HC A03/MF A01 CSCL 20/6

An optical coupler for transferring light or near IR radiation between high index integrated optics structures such as LiNbO3 and low loss optical fibers was developed. The design is a flexible glass fiber containing an external ridge guiding region on a larger lower index base material. Ridge dimensions down to 2 micrometers were obtained, indicating that single or multimode designs are possible. Special glasses which had refractive index values in excess of 2.20 at 632.9 nm were developed for the coupler fiber. The design utilizes evanescent wave coupling at the integrated optics structure and end fire coupling at the optical fiber. Author (GRA)

DATA SUMMARY: Measurements of refractive index and internal transmission of various glass compositions; variables include refractive index, internal transmission, 5 PbO in glass, and chemical composition; 3 figures and 1 table include numeric data.

**N77-19863#** RCA Labs., Princeton, N.J.
**OPTIMIZED LED FOR SINGLE-FIBER OPTICAL LINKS Final Report, 3 Feb. 1975 - 1 Feb. 1976**
James P. Wittke, Michael Ettenberg, and Henry Kressel Mar. 1976 80 p refs
(Contract N00014-75-C-0365)
(AD-A030177; PRRL-76-CR-15) Avail: NTIS HC A05/MF A01 CSCL 09/1

The power coupled into an N.A. = 0.15, 90-micrometers core, multimode fiber from an edge-emitting, light-emitting diode has been significantly increased by the development of the narrow active region, double-heterojunction (DH) LED. As much as 0.8 mW has been coupled into a single fiber. The new diode structure results in a narrow (approx. 25 deg FWHM) emitted beam (in the direction perpendicular to the junction plane), and leads to optical coupling efficiencies 3 to 5 dB better than previously achieved. The radiance of the emitting facet is greatly increased, to over 1000 W/sq cm--sr, a factor of 10 greater than previously reported. The new structure also results in LEDs that can be modulated at high frequencies (150 MHz). Coupling from the narrow-active-region, DH diodes into the fiber is further enhanced, by about 3 dB, with the use of a microlens melted onto the fiber end. Overall coupling efficiencies of 9 to 11 dB are achieved. With the high modulation speed and coupled power of these diodes, material dispersion effects in the fiber, rather than signal power or diode speed, limit the usable distance-bandwidth product. Author (GRA)

DATA SUMMARY: Diverse data are presented; variables include modulation frequency, relative diode response, current density, peak drive current, peak power emitted, diode current, emission wavelength, emission intensity, time, and LED output power.

**N77-19864#** Itek Corp., Lexington, Mass. Optical Systems Div.

**CHARACTERIZATION OF THE PROM FOR COHERENT OPTICAL PROCESSING APPLICATIONS Final Technical Report, Apr. 1975 - Jul. 1976**

V. Bennett, S. Iwasa, J. Frattarola, T. Sparks, and P. Nisenson 9 Aug. 1976 79 p refs

(Contract DAAG53-75-C-0132; DA Proj. 4A1-61102-B-52C) (AD-A030137; ETL-0053) Avail: NTIS HC A05/MF A01 CSCL 20/6

The effort was divided into two primary tasks as follows: Task 1 - Image Plane Processing and Cross-Correlation-- Using a pair of stereo transparencies of a laboratory slope model, photographs of constant elevation fringes were obtained using 5 mw of HeNe laser for PROM readout. The technique was shown to be feasible and it was determined that significantly more readout illumination, such as 50 nw or more from the Krypton 647 nm line, would be required for a usable image reconstruction which displays the contours. Task 2 - Fourier Plane Filtering-- (a) PROM Filtering. Complex Vander Lugt filters were exposed on the PROM and film and reconstructed. A comparison of the PROM and film filters was discussed. (b) Pattern Generator/PROM. Various programmable filter patterns were written on the PROM and the characteristics of the Laser Raster Generator (LRG) were analyzed. A tradeoff study of LRG spot size versus scan overlap was performed. (c) Minicomputer PROM Filters. Versatile software for filter computation on the HP 2116C minicomputer was written, checked out, and demonstrated with the LRG and PROM. Software for fast disk readout to the LRG was also demonstrated. (d) Two-PROM System. The feasibility of real-time optical processing was demonstrated using two PROM devices. The first PROM was used in the input image plane as an incoherent-to-coherent converter and the second PROM was used as a laser addressed, programmable Fourier plane filter. Low-pass filtering, orientation selection, and spatial differentiation were demonstrated.

Author (GRA)

DATA SUMMARY: acousto-optic deflector intensity variation across field; variables includes relative density, distance, relative irradiance, spatial frequency, diffraction efficiency, acoustic frequencies, modulation transfer, exposure time, position, and scan rate; 14 figures and 2 tables include numeric data.

**N77-19865#** Army Aeromedical Research Lab., Fort Rucker, Ala.

**DEPTH PERCEPTION WITH THE AN/PVS-5 NIGHT VISION GOGGLE Final Report**

Roger W. Wiley, David D. Glick, Carol T. Bucha, and Chun K. Park Jul. 1976 22 p refs

(DA Proj. 3A0-62110-A-819)

(AD-A029542; USAARL-76-25) Avail: NTIS HC A02/MF A01 CSCL 20/5

Laboratory measures of stereopsis and field measures of relative depth discrimination while using the AN/PVS-5 Night Vision Goggle were determined and compared with data of unaided eye performance. Using a modified Howard-Dolman apparatus, the stereoscopic threshold was found to be considerably degraded with the man-goggle system when compared to photopic unaided eye performance. Field measurements of relative depth discrimination using all available visual cues showed that performance of the man-goggle system was statistically equivalent only at intermediate distances of 500 feet or less. GRA

DATA SUMMARY: Relative depth threshold was calculated using Howard-Dolman apparatus; variables include linear threshold, angular threshold, target size, testing distance, and observation distance; 2 figures and 3 tables include numeric data.

**N77-19866#** Naval Weapons Center, China Lake, Calif.

**OPTICAL FUNCTIONAL TESTER: AN IMPROVED DESIGN Final Report, Dec. 1974 - Dec. 1975**

D. L. Decker, H. E. Bennett, and D. A. Dobberpuhl Jul. 1976 32 p refs

(AD-A030101; NWC-TP-5872) Avail: NTIS HC A03/MF A01 CSCL 20/6

A redesign of the Optical Functional Tester (OFT) has been completed. The initial unit of the new design has been assembled and operated. Laboratory checkout has shown the versatility of the new design, its ease of operation, and adequate measurement sensitivity when compared to the original OFT. This new unit has been operated both in the forward and backscatter modes. Test data (x-y recorder traces) on surfaces of three different types of laser designator components (laser rods, Pockels cell crystals, and resonator end reflectors) is presented. Recommendations for further application of the unit are given. Potential computerization of the unit is discussed. An estimated cost breakdown for follow-on units is included. Author (GRA)

DATA SUMMARY: Backscatter and forward scanner scan series for various surfaces at a wavelength 6328; variables included angular position and scattered light; 6 figures include numeric data.

**N77-19867#** National Bureau of Standards, Washington, D.C. Optics Physics Div.

**OPTICAL RADIATION MEASUREMENTS: THE TRANSLUCENT BLURRING EFFECT - METHOD OF EVALUATION AND ESTIMATION Final Report**

Jack J. Hsia Oct. 1976 34 p refs Sponsored by Dept. of Commerce

(PB-259639/3; NBS-TN-594-12) Avail: NTIS HC A03/MF A01 CSCL 14B

The translucent phenomenon which causes flux loss in the spectrophotometric measurement is described. Methods for mathematically evaluating the flux loss are examined, and experimental methods using laser and conventional light sources are described. A widely used Vitrolite glass standard is employed to demonstrate the error estimation and correction. GRA

DATA SUMMARY: Flux reflected by a Vitrolite glass sample was measured with and without mask, with normal incidence and 45 deg viewing; variables include mask radius, beam radius, fraction received, % loss, reflected flux, distance from center, and misalignment; 9 figures include numeric data.

# 75 PLASMA PHYSICS

Includes magnetohydrodynamics and plasma fusion.

For ionospheric plasmas see *46 Geophysics*. For space plasmas see *90 Astrophysics*.

**N77-19868*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

**A HEAVY ION BEAM PROBE SYSTEM FOR INVESTIGATION OF A MODIFIED PENNING DISCHARGE**

George X. Kambic and Walter M. Krawczonek Mar. 1977 34 p refs

(NASA-TM-X-3485; E-8869) Avail: NTIS HC A03/MF A01 CSCL 20I

An ion beam probe diagnostic system can measure time- and space-resolved profiles of plasma space potential and electron density. In combination with a computer iterative technique, the ion beam probe can determine both the space potential profile in plasmas containing strong electric fields and potentials comparable in magnitude to the energy of the probing ion beam. During ion beam probing of a modified Penning discharge, several groups of secondary ions were observed coming from the plasma with a fixed primary beam energy and momentum. The energies of these ions were within 10 percent of the values predicted by a computer-generated model of the potential profile in the plasma. The mechanical and electronic components of the system are described, with particular emphasis on those features required to probe plasma potentials comparable in magnitude to the ion beam energy. Author

**N77-19869#** Princeton Univ., N.J. Plasma Physics Lab.
**PLASMA RINGING ASSOCIATED WITH PULSED RESONANCE CONES**
P. M. Bellan Jun. 1976 19 p refs
(Contract E(11-1)-3073)
(MATT-1260) Avail: NTIS HC A02/MF A01

A temporal wave-packet of frequency omega (0) applied to a finite antenna in a magnetically confined plasma, excites an electrostatic field consisting of (1) a short-duration resonance cone, and (2) a wave-like disturbance which follows afterwards. This latter disturbance, persists long after the resonance cone. The phase factor associated with the disturbance is independent of omega (0), and its constant-phase surface are lines which emanate from the antenna and make a small angle theta with respect to the confining magnetic field B. Theta decreases with increasing time so that wavelengths perpendicular to B also decrease with increasing time. The correspondence of the fields obtained by wave-packet excitation to those obtained by both CW and delta-function excitations is discussed and experimental results are reported. ERA

**N77-19870#** Princeton Univ., N.J. Plasma Physics Lab.
**SHEAR STABILIZATION OF DRIFT INSTABILITIES IN THE PRESENCE OF MULTIPLE RATIONAL SURFACES**
M. True, W. W. Lee, and H. Okuda Jul. 1976 16 p refs
(Contract E(11-1)-3073)
(MATT-1270) Avail: NTIS HC A02/MF A01

Shear stabilization of collisionless drift instabilities and the associated plasma transport in the presence of multiple rational surfaces was studied analytically and by numerical simulation using a slab model. The multiple rational surfaces reduce the energy loss due to wave convection and therefore the stabilization by shear becomes less effective. The anomalous plasma transport is enhanced accordingly. ERA

**N77-19871#** Princeton Univ., N.J. Plasma Physics Lab.
**LOWER HYBRID INSTABILITY DRIVEN BY A SPIRALING ION BEAM**
S. Seiler, M. Yamada, and H. Ikezi (Bell Telephone Labs., Murray Hill, N. J.) Jul. 1976 11 p refs
(Contract E(11-1)-3073)
(MATT-1268) Avail: NTIS HC A02/MF A01

A lower hybrid instability with ion cyclotron harmonics is observed to be resonantly driven by an ion beam injected obliquely to the confining magnetic field, in agreement with a linear, warm plasma theory. Quasilinear velocity space diffusion of the beam is observed. ERA

**N77-19872#** Los Alamos Scientific Lab., N.Mex.
**COMMERCIAL APPLICATION OF LASER FUSION**
L. A. Booth 1976 26 p refs Presented at Advisory Group Meeting on the Technol. of Inertial Confinement Expt., Dubna, USSR, 19-23 Jul. 1976; sponsored by IAEA
(Contract W-7405-eng-36)
(LA-UR-76-1459; Conf-760723-1) Avail: NTIS HC A03/MF A01

The fundamentals of laser-induced fusion, some laser-fusion reactor concepts, and attendant means of utilizing the thermonuclear energy for commercial electric power generation are discussed. Theoretical fusion-pellet microexplosion energy release characteristics are described and the effects of pellet design options on pellet-microexplosion characteristics are discussed. The results of analysis to assess the engineering feasibility of reactor cavities for which protection of cavity components is provided either by suitable ablative materials or by diversion of plasmas by magnetic fields are presented. Two conceptual laser-fusion electric generating stations, based on different laser-fusion reactor concepts, are described. ERA

**N77-19873#** California Univ., Livermore. Lawrence Livermore Lab.
**CYCLINDRICAL AND SPHERICAL SOLITONS**
Stephen Maxon Jun. 1976 24 p refs Presented at Conf. on Solitons, Tucson, Ariz., 5 Jan. 1976
(UCRL-78341; Conf-760135-1) Avail: NTIS HC A02/MF A01

Cylindrical and spherical ion acoustic solitons in a cold, single species plasma are reviewed. The properties of these higher dimensional solitons are quite different from their planar counterpart since the amplitude increases, the width decreases, and the propagation speed increases as the soliton moves inward. Although the results for two- and three-dimensional solitons are obtained numerically, early time solutions are found analytically and compared with numerical solutions. An interesting phenomenon, which is an integral part of these higher dimensional solitons, is the presence of a wake. Although the amplitude of this wake is very small, it carries considerable momentum since it extends over a large spatial region. ERA

**N77-19874#** Los Alamos Scientific Lab., N.Mex.
**PRELIMINARY TIME RESPONSE DATA FROM ITT MCP PMT**
P. B. Lyons 1976 13 p
(Contract W-7405-eng-36)
(LA-UR-76-1441) Avail: NTIS HC A02/MF A01

Preliminary data obtained with an ITT image intensifier tube operated as a photomultiplier are presented. Some applications such as weapons diagnostics, laser plasma diagnostics, and diagnostic developments such as fast radiation-to-light converters, and fiber optic pulse dispersion are described. ERA

**N77-19875#** Princeton Univ., N.J. Plasma Physics Lab.
**RESIDUAL TRAPPED-ION INSTABILITIES IN TOKAMAKS**
W. M. Tang, J. C. Adam, and D. W. Ross Jul. 1976 24 p refs
(Contract E(11-1)-3073)
(MATT-1265) Avail: NTIS HC A02/MF A01

It is demonstrated that in addition to the usual dissipative trapped-ion instability, which is basically an electron diamagnetic drift mode, ion diamagnetic modes of this type can also be generated. Such modes can be driven unstable by ions which have average unfavorable magnetic drifts and can persist as residual instabilities in Tokamak systems with flat or reversed gradient profiles. ERA

**N77-19876#** Princeton Univ., N.J. Plasma Physics Lab.
**NEW THREE-DIMENSIONAL SIMULATION MODELS FOR CYLINDRICAL AND TOROIDAL PLASMAS**
C. Z. Cheng and H. Okuda Jul. 1976 38 p refs
(Contract E(11-1)-3073)
(MATT-1204) Avail: NTIS HC A03/MF A01

A class of three dimensional particle simulation models using finite-size particles was developed which is useful for studying plasma behavior in large, cylindrical, and toroidal systems. The model makes use of the combination of eigenfunction of eigenfunction expansion and the multi-pole expansion on a two-dimensional spatial grid for solving the Maxwell equations and for pushing particles. For a toroidal system, the Poisson equation is solved by using the cubic spline technique in the radial direction. It is shown that full three dimensional simulations may be carried out for real plasma devices such as Tokamaks or pinch devices using the presently available computers. Results of the simulations for the thermal fluctuations are shown to agree with the theoretical predictions for both cylindrical and toroidal systems. ERA

**N77-19877#** Princeton Univ., N.J. Plasma Physics Lab.
**PARTICLE DIFFUSION IN TOROIDALLY SYMMETRIC SYSTEMS**
A. H. Boozer Jul. 1976 22 p refs
(Contract E(11-1)-3073)
(EPRI-3) Avail: NTIS HC A02/MF A01

Since the two fluid equations of a plasma are expressions of momentum conservation, they must hold independent of the mean free path to system size ratio. Diffusion in a toroidally symmetric torus is calculated with the two fluid equations, using Pfirsch-Schlueter diffusion and neoclassical diffusion as examples. ERA

**N77-19878#** California Inst. of Tech., Pasadena.
**WAVE HEATING AND DIAGNOSTICS FOR FUSION PLASMAS Progress Report, 15 May 1975 - 14 May 1976**
R. W. Gould 14 May 1976 110 p refs
(Contract AT(04-3)-767)
(CALT-767P2X4) Avail: NTIS HC A06/MF A01

Brief summaries of progress during this period are given for

the following areas: (1) research Tokamak facility, (2) poloidal field coil design technique, (3) externally driven linear electromagnetic modes of an anistropic hot plasma, (4) transient response from a small antenna in an anisotropic plasma, (5) electrostatic wave propagation and instabilities in a magnetized plasma, (6) Thomson scattering diagnostics, and (7) MHD mode survey. ERA

**N77-19879#** California Univ., Livermore. Lawrence Livermore Lab.

**LASER BEAM TRAPPING AND PROPAGATION IN CYLINDRICAL PLASMA COLUMNS**

M. D. Feit and J. A. Fleck, Jr. 28 May 1976 14 p refs Presented at IEEE Conf. on Plasma Sci., Austin, Tex., 24 May 1976

(Contract W-7405-eng-48)

(UCRL-77842; Conf-760546-3) Avail: NTIS HC A02/MF A01

An analysis of the scheme to heat magnetically confined plasma columns to kilovolt temperatures with a laser beam is discussed which requires consideration of two propagation problems. The first question is whether stable beam trapping is possible. Since the laser beam creates its own density profile by heating the plasma, the propagation of the beam becomes a nonlinear phenomenon, but not necessarily a stable one. In addition, the electron density at a given time depends on the preceeding history of both the medium and the laser pulse. A self-consistent time dependent treatment of the beam propagation and the medium hydrodynamics is consequently required to predict the behavior of the laser beam. Such calculations were carried out and indicate that propagation of a laser beam in an initially uniform plasma can form a stable filament which alternately focuses and defocuses. An additional question that is discussed is whether diffractive losses associated with long propagation paths are significant. ERA

**N77-19880#** Oak Ridge National Lab., Tenn.

**ROLE OF IMPURITIES IN MAGNETICALLY CONFINED HIGH TEMPERATURE PLASMAS**

C. F. Barnett 1976 19 p refs Presented at 5th Intern. Conf. on Atomic Phys., Berkeley, Calif., 26 Jul. 1976

(Contract W-7405-eng-26)

(CONF-760730-1) Avail: NTIS HC A02/MF A01

The atomic physics concerned with plasma cooling by impurities and the limiting effect that impurities may have on heating of plasmas by neutral injection is presented. A general description is given of the Tokamak concept and the present and next generation experiments are described. The time and spatial behavior of O and Mo multicharged ions in present hydrogen plasmas is presented. This is followed by a discussion of the power loss from a plasma containing one percent Fe. The limitation of plasma heating by energetic H or D injection is also summarized. ERA

**N77-19881#** Oak Ridge National Lab., Tenn.

**ELMO BUMPY TORUS PROGRAM**

R. A. Dory and H. O. Eason Apr. 1976 37 p refs

(Contract W-7405-eng-26)

(ORNL/TM-5451) Avail: NTIS HC A03/MF A01

Theoretical and experimental research on the ELMO bumpy torus (EBT) is reviewed. It is proposed to continue research in the following areas: (1) increasing the EBT magnetic field to permit microwave heating at 18 and 28 GHz; (2) fabricating a superconducting bumpy torus, EBT-2, to permit microwave heating at 90 and 120 GHz; and (3) design a EBT-T to test the technology scaling of a very high power microwave heated device. ERA

**N77-19882#** Iowa State Univ. of Science and Technology, Ames. Engineering Research Inst.

**APPLICATION OF FUSION PLASMA TECHNOLOGY Final Report, 1 Apr. 1974 - 30 Jun. 1975**

Zeinab A. Sabri Jun. 1976 60 p refs

(Contract AT(11-1)-2457; ERI Proj. 1126)

(COO-2457-3; ISU-ERI-AMES-76367) Avail: NTIS HC A04/MF A01

Two tasks were considered. The first was to identify and investigate plasma processes for near term industrial applications of already developed plasma technology. The second was to explore the potential of reprocessing the fuel for fusion test facilities in a closed-cycle system. For the first task, two applications were considered. One was alumina reduction in magnetically confined plasmas, and the other was uranium enrichment using plasma centrifuges. For the second task, in-core and ex-core plasma purification were considered. Separation techniques that are compatible with the plasma state were identified and preliminary analysis of their effectiveness was carried out. The effects of differential ionization of impurities on the separation effectiveness are considered. ERA

**N77-19883#** General Atomic Co., San Diego, Calif.

**GENERAL ATOMIC NONCIRCULAR TOKAMAK DEMONSTRATION POWER REACTOR: BLANKET/SHIELD, TRITIUM AND POWER CONVERSION SYSTEMS**

19 Mar. 1976 60 p refs Presented at the Blanket/Power Systems for Fusion Reactors Workshop, Upton, N. Y., 29 Mar. - 2 Apr. 1976

(Contract E(04-3)-167)

(GA-A-13896; Conf-760343-2) Avail: NTIS HC A04/MF A01

A reference conceptual design for a noncircular Tokamak power reactor was established and developed. The major design parameters of the reactor are given. The reactor has a 7 m major radius and a net electrical output just over 500 MW(e). A primary engineering objective in the design is the minimization of expensive and time-consuming remote maintenance operations by designing the reactor to permit hands-on maintenance externally to the shield system and toroidal field coils. To this end the outboard shield is comprised of low activity materials, and flux levels at the toroidal field coils are intentionally reduced to levels well under those based on coil refrigeration and annealing criteria. A conventional steam power conversion cycle is briefly described. ERA

**N77-19884#** California Univ., Livermore. Lawrence Livermore Lab.

**COMPUTATION OF MACH REFLECTION FROM RIGID AND YIELDING SURFACES**

Alfred C. Buckingham and Sharon S. Wilson 1976 34 p refs Presented at 9th AIAA Fluid and Plasma Dyn., San Diego, Calif., 14-16 Jul. 1976

(Contract W-7405-eng-48)

(UCRL-77640; Conf-760708-2) Avail: NTIS HC A03/MF A01

A theoretical description of one aspect of the irregular or Mach reflection from solid surfaces is presented. Analytical considerations and some preliminary results using model approximations to the surface interaction phenomena are provided. Some of the considerations on boundary conditions are submitted for numerical treatment of the gas solid interface. Analysis and discussion of a yielding solid surface subjected to impulsive loading from an intense gas shock wave follows. This is used as a guide for the development of the numerical procedure. Mach reflection processes are then briefly reviewed with special attention for similitude and singular perturbation features. ERA

**N77-19885#** Los Alamos Scientific Lab., N.Mex.

**TEMPERATURE- AND DENSITY-DEPENDENT X-RAY SCATTERING IN A LOW-Z PLASMA**

R. T. Brown Jun. 1976 12 p refs

(Contract W-7405-eng-36)

(LA-6391-MS) Avail: NTIS HC A02/MF A01

A computer program is described which calculates temperature and density dependent differential and total coherent and incoherent X-ray scattering cross sections for a low-Z scattering medium. Temperature and density are arbitrary within the limitations of the validity of local thermodynamic equilibrium, since ionic populations are calculated under this assumption. Scattering cross sections are calculated in the form factor approximation. The scattering medium may consist of any mixture of elements with Z less than or equal to 8, with this limitation imposed by the availability of atomic data. ERA

**N77-19886#** Princeton Univ., N.J. Plasma Physics Lab.

**QUENCHING OF THE CURRENT-DRIVEN ION-WAVE INSTABILITY IN THE TRAPPED-ELECTRON REGIME IN A TOROIDAL PLASMA**

V. Arunasalam, M. Okabayashi, R. J. Hawryluk, and S. Suckewer Jul. 1976 56 p refs

(Contract E(11-1)-3073)
(MATT-1266) Avail: NTIS HC A04/MF A01

An analysis is presented of an experimental study of the scattering of microwaves by density fluctuations due to the current-driven ion acoustic wave instability in a toroidal plasma confinement device, the FM-1 spherator. It is found that the instability exists only in the collisional regime and it is inhibited in the trapped-electron banana regime. Further, it is found that for two different values of the ratio of the trapped to untrapped electron number density (i.e., for both 70 percent and 40 percent mirror trapping). Finally, it is shown that the nature of this inhibition is in general agreement with the recent theoretical notion that in the banana regime the entire ohmic heating current is carried only by the freely circulating electrons. ERA

**N77-19887#** Oak Ridge National Lab., Tenn.
**MAGNETOHYDRODYNAMIC EQUILIBRIA AND LOCAL STABILITY OF AXISYMMETRIC TOKAMAK PLASMAS**
Y. K. M. Peng, R. A. Dory, D. B. Nelson, and R. O. Sayer Jul. 1976 50 p refs
(Contract W-7405-eng-26)
(ORNL/TM-5267) Avail: NTIS HC A03/MF A01

Axisymmetric magnetohydrodynamic equilibria are evaluated in terms of the Mercier Stability Criterion. Parameters studied include poloidal beta, current and pressure profile widths, D-shaped and doublet plasmas with elongation (sigma) and triangularity (delta), and the aspect ratio (A). For marginal local stability, the critical values of beta, plasma current, and the safety factor q with fixed toroidal field at the geometric center of the plasma are obtained. It is shown that for a wide range of profiles in a D-shaped plasma with A = 3, the highest critical beta occurs at beta/sub p/ = 2.4, sigma = 1.65, and delta = 0.5. Critical values of ohmic heating power density are also found to be comparable for the two plasma shapes. A D-shaped plasma with the above parameters is suggested for use in future high-beta Tokamak devices. ERA

**N77-19888#** Royal Inst. of Tech., Stockholm (Sweden). Dept. of Electron Physics.
**MEASUREMENTS OF ELECTRON ENERGY DISTRIBUTIONS IN FRONT OF AND BEHIND A STATIONARY PLASMA SHEATH**
Dag Andersson Jul. 1976 21 p refs Submitted for publication
(TRITA-EPP-76-10) Avail: NTIS HC A02/MF A01

Electron energy distributions were measured in front of and behind a stationary plasma sheath in a low pressure mercury discharge. The sheath appears at a constriction of the discharge tube. The measurements were done with a spheric probe, using the second-derivative method, and the results show that the energy distribution on the anode side of the sheath is a sum of a Maxwellian part and an accelerated distribution. Near the sheath the accelerated electrons suffice to carry the discharge current, but far from it the current is carried by an anisotropy in the thermal part of the distribution function. A simple comparison is made with distribution functions calculated under different assumptions. The cross-sections for electron-neutral and Coulomb collisions are not sufficient to account for the damping of the accelerated population along the tube, suggesting that a plasma instability must be present. Author (ESA)

**N77-19889#** Royal Inst. of Tech., Stockholm (Sweden). Dept. of Plasma Physics and Fusion Research.
**DATA ON ROTATING PLASMA OPERATION IN TORNADO TRAPS**
B. Lehnert 23 Jun. 1976 67 p refs
(TRITA-EPP-76-11) Avail: NTIS HC A04/MF A01

The potentialities and data of rotating plasma operation in tornado traps (spiral coils) were examined with respect to a number of writing effects. Rotating plasma operation in spiral coil tornado traps provides a unique combination of confinement and heating properties. Such a system consists of a closed and compact magnetic bottle to which the crossed-field technique can be applied, in the absence of end insulators and their critical velocity limitation effect. This should make possible the generation and heating of fully ionized plasmas by simple means, within a large range of ion densities, temperatures, and rotational velocities. Provided that stable operation becomes possible at high temperatures, it is likely that tornado traps can be used as strong neutron sources of moderately large dimensions and technically realizable parameter values. Some detailed data and operation ranges are given for the tornado 650 device in Leningrad, and for a somewhat larger device to be operated as neutron source. Author (ESA)

**N77-19890#** Materials Quality Assurance Directorate, London (England).
**ANALYTICAL EMISSION SPECTROGRAPHY WITH THE INDUCTION-COUPLED ARGON PLASMA SOURCE. PART 2: ANALYSIS OF NICKEL-BASE ALLOYS**
B. T. N. Newland and R. A. Mostyn Jun. 1976 18 p refs
(MQAD-R-242-Pt-2; BR53820) Avail: NTIS HC A02/MF A01

An induction-coupled argon plasma source, combined with an ultrasonic nebulizing system and a large quartz spectrograph, was applied to the determination of cobalt (0.25 to 1.25%), iron (0.2 to 0.4%), manganese (0.05 to 0.25%), tantalum (0.03 to 0.35%), titanium (0.8 to 1.5 %), and zirconium (0.04 to 0.2%) in nickel alloys. The precision, with nickel as internal standard, is of the order 2 to 3%. No serious matrix effects were encountered. Author (ESA)

**N77-19891#** Colorado Univ., Boulder. Dept. of Astro-Geophysics.
**PUMP WAVENUMBER DEPENDENT EFFECTS IN THE PARAMETRIC INSTABILITIES OF A PLASMA Final Report Ph.D. Thesis**
Steven J. Bardwell 31 Jul. 1976 160 p refs
(Contract F44620-73-C-0003; AF Proj. 9751)
(AD-A031292; CU-1019-A5; AFOSR-76-1116TR-Attach-5)
Avail: NTIS HC A08/MF A01 CSCL 20/9

This paper derives a linear kinetic theory of parametric instabilities in an infinite, homogeneous, fully ionized plasma, with no magnetic field. Important problems of the parametric instabilities are studied, in three dimensions, pumped by a monochromatic, longitudinal pump or arbitrary wavevector. By solving a dispersion relation derived for these instabilites, numerically and analytically, a number of new, three-dimensional effects are found. GRA

**N77-19892#** Colorado Univ., Boulder. Dept. of Astro-Geophysics.
**TRANSPORT PROCESSES WITHIN A PLASMA DRIVEN BY A HIGH-FREQUENCY ELECTRIC FIELD Final Report Ph.D. Thesis**
Dean E. McKinnis 31 Jul. 1976 92 p refs
(Contract F44620-73-C-0003; AF Proj. 9751)
(AD-A031291; CU-1019-A4; AFOSR-76-1116TR-Attach-4)
Avail: NTIS HC A05/MF A01 CSCL 20/9

A method is described for calculating transport coefficients within a plasma driven by a high-frequency alternating electric field. The method involves a collision term expressed in the Klimontovich form, and does not require the field to be weak. Representative calculations are made for a nonrelativistic, non-degenerate, two-component, magnetic-field-free plasma by using a large-wave-number functional form to simplify some sums over wave number; expressions are derived for thermal conductivity, electron resistive heating (inverse Bremsstrahlung) rate, and interspecies heat exchange rate as functions of electric field strength. Numerical values are given for the three functions. Author (GRA)

**N77-19893#** Naval Research Lab., Washington, D.C. Plasma Dynamics Branch.
**THERMAL FORCE CONTRIBUTIONS TO SELF-GENERATED MAGNETIC FIELDS IN LASER-PRODUCED PLASMAS Interim Report**
D. G. Colombant (Sci. Appl., Inc., McLean, Va.) and N. K. Winsor Sep. 1976 23 p refs
(NRL Proj. H02-29B)
(AD-A031204; NRL-MR-3362) Avail: NTIS HC A02/MF A01 CSCL 20/9

The several magnetic source terms affecting laser-produced plasmas are presented and their importance discussed. The thermal force is shown to greatly modify the magnetic field distribution. The hard X-ray spectrum is quantitatively compared with the experiment. Author (GRA)

**N77-19894#** Air Force Geophysics Lab., Hanscom AFB, Mass.
**HYDROMAGNETIC WAVES: TEMPORAL DEVELOPMENT OF COUPLED MODES Environmental Research Papers**
Henry R. Radoski 6 May 1976 35 p refs
(AF Proj. 7601)
(AD-A030331; AFGL-TR-76-0104; AFGL-ERP-559) Avail: NTIS HC A03/MF A01 CSCL 20/9

Numerical solutions to the initial value problem have been obtained for the guided (toroidal) and isotropic (poloidal) electric fields of hydromagnetic waves for the asymmetric case. The cylindrical model of the inner magnetosphere has been used in which the field lines are arcs of circles and the surface of the earth is planar. The cases considered have the initial disturbance completely restricted to either the guided or isotropic field components to emphasize the effect of coupling. The large spatial variation of the magnetic field in these resonance regions must be associated with large field aligned currents. Author (GRA)

**N77-19895#** Naval Research Lab., Washington, D.C.
**THE TRAPPED ELECTRON MODE DOES NOT GIVE RISE TO ANOMALOUS HEATING**
W. M. Manheimer, E. Ott, and W. M. Tang Aug. 1976 12 p refs
(Contract E(49-20)-1006; NRL Proj. H02-37)
(AD-A030618; NRL-MR-3347) Avail: NTIS HC A02/MF A01 CSCL 20/9

It is shown that in steady state the dissipative trapped electron mode does not give rise to net plasma heating. However, it does cause anomalous energy exchange between electron and ions, with the ions heating and the electrons cooling.
Author (GRA)

**N77-19896#** Naval Research Lab., Washington, D.C.
**ULTRAVIOLET AND VISIBLE EMISSION CONTINUA OF KrF AND XeF**
J. Gray Eden Sep. 1976 14 p refs
(NRC Proj. K03-53)
(AD-A030175; NRL-MR-3356) Avail: NTIS HC A02/MF A01 CSCL 20/5

Spectroscopic studies of XeF and KrF electronically excited molecules in electron beam produced rare gas-halogen plasmas have been conducted. Experimental evidence indicates that the 248 and 275 nm emission bands of the KrF* complex originate from separate upper states. These continua are assigned to CtoX and BtoA transitions, respectively, of electronically excited KrF. Due to similarities in structure and emission spectra, an analogous situation is believed to exist in XeF. Author (GRA)

**N77-19897#** United Technologies Research Center, East Hartford, Conn.
**INVESTIGATION OF THE STABILITY OF IONIZED MOLECULAR GAS FLOWS Final Report, 15 Mar. 1972 - 30 Sep. 1976**
William L. Nighan 30 Sep. 1976 156 p refs
(Contract N00014-72-C-0380)
(AD-A030281; R76-921325-6) Avail: NTIS HC A08/MF A01 CSCL 20/5

The causes of thermal instability in externally sustained molecular discharges have been examined theoretically. The results of this study show that externally sustained discharges of the type used in CO2 lasers are inherently unstable. There are two distinct mechanisms which can drive thermal instability: (1) an increase in electron-molecule vibrational excitation, and (2) vibrational reservoir collapse. The plasma conditions and collision processes contributing to the occurrence of these instabilities are discussed in detail. GRA

## 76 SOLID-STATE PHYSICS

Includes superconductivity.

For related information, see also *33 Electronics and Electrical Engineering* and *36 Lasers and Masers*.

**N77-19898*#** International Business Machines Corp., Hopewell Junction, N.Y. Systems Product Div.
**SILICON RIBBON GROWTH BY A CAPILLARY ACTION SHAPING TECHNIQUE Quarterly Progress Report**
G. H. Schwuttke, T. F. Ciszek, and A. Kran 15 Mar. 1976 87 p refs Prepared for JPL
(Contracts NAS7-100; JPL-954144)
(NASA-CR-149815; QPR-3) Avail: NTIS HC A05/MF A01 CSCL 20L

The technique of silicon ribbon growth by the capillary action shaping is assessed for applicability to photovoltaic power device material. Ribbons 25 mm in width and up to 0.5 m in length have been grown from SiC dies, and some new characteristics of growth from such dies have been identified. Thermal modifiers have been studied, and systems were developed which reduce the frozen-in stress un silicon ribbons and improve the thickness uniformity of the ribbons. Preliminary spreading resistance measurements indicate that neither surface striations nor twin boundaries give rise to appreciable resistivity variations, but that large-angle grain boundaries cause local resistivity increases of up to 200%. Author

**N77-19899*#** International Business Machines Corp., Hopewell Junction, N.Y. Systems Product Div.
**SILICON RIBBON GROWTH BY A CAPILLARY ACTION SHAPING TECHNIQUE Annual Report**
G. H. Schwuttke, T. F. Ciszek, and A. Kran 15 Jun. 1976 74 p refs Prepared for JPL
(Contracts NAS7-100; JPL-954144)
(NASA-CR-149814; ERDA/JPL-954144-76/01; QTPR-4) Avail: NTIS HC A04/MF A01 CSCL 20L

The crystal growth method described is a capillary action shaping technique. Meniscus shaping for the desired ribbon geometry occurs at the vertex of a wettable die. As ribbon growth depletes the melt meniscus, capillary action supplies replacement material. A capillary die is so designed that the bounding edges of the die top are not parallel or concentric with the growing ribbon. The new dies allow a higher melt meniscus with concomitant improvements in surface smoothness and freedom from SiC surface particles, which can degrade perfection. Author

**N77-19900*#** National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
**ON THE DISSOLUTION PROPERTIES OF GaAs IN Ga**
M. C. Davidson and A. H. Moynahan (Univ. of Cork, Ireland) Jan. 1977 22 p refs
(NASA-TM-X-73368) Avail: NTIS HC A02/MF A01 CSCL 20L

The dissolution of GaAs in Ga was studied to determine the nature and cause of faceting effects. Ga was allowed to dissolve single crystalline faces under isothermal conditions. Of the crystalline planes with low number indices, only the (100) surface showed a direct correlation of dissolution sites to dislocations. The type of dissolution experienced depended on temperature, and there were three distinct types of behavior.
Author

**N77-19901*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**THE USE OF ANALYTICAL SURFACE TOOLS IN THE FUNDAMENTAL STUDY OF WEAR**
Donald H. Buckley 1977 64 p refs Proposed for presentation at Intern. Conf. on Wear of Mater., St. Louis, 25-27 Apr. 1977; sponsored by ASME
(NASA-TM-X-73437; E-8792) Avail: NTIS HC A04/MF A01 CSCL 20L

Various techniques and surface tools available for the study of the atomic nature of the wear of materials are reviewed These include chemical etching, x-ray diffraction, electron diffraction, scanning electron microscopy, low-energy electron diffraction, Auger emission spectroscopy analysis, electron spectroscopy for chemical analysis, field ion microscopy, and the atom probe. Properties of the surface and wear surface regions which affect wear, such as surface energy, crystal structure, crystallographic orientation, mode of dislocation behavior, and cohesive binding, are discussed. A number of mechanisms involved in the generation of wear particles are identified with the aid of the aforementioned tools. Author

**N77-19902*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
**BAND STRUCTURE OF W AND Mo BY EMPIRICAL PSEUDOPOTENTIAL METHOD**
C. Guha Sridhar and Ellis E. Whiting Feb. 1977 29 p refs
(NASA-TM-X-73206; A-6915) Avail: NTIS HC A03/MF A01 CSCL 20L

The empirical pseudopotential method (EPM) is used to calculate the band structure of tungsten and molybdenum. Agreement between the calculated reflectivity, density of states, density of states at the Fermi surface and location of the Fermi surface from this study and experimental measurements and previous calculations is good. Also the charge distribution shows the proper topological distribution of charge for a bcc crystal.
Author

**N77-19903#** Cornell Univ., Ithaca, N.Y.
**STRUCTURE AND PROPERTIES OF GRAIN BOUNDARIES Progress Report, 1 May 1975 - 31 Jan. 1976**
R. W. Balluffi Jan. 1976 24 p refs
(Contract E(11-1)-2679)
(COO-2679-7) Avail: NTIS HC A02/MF A01

A broad investigation of the structure and properties of grain boundaries has been conducted. The approach was mainly experimental, and extensive use was made of high resolution methods of investigating grain boundaries in specimens containing boundaries of controlled geometry. Progress was made in the following areas: (1) methods for preparing thin-film specimens containing boundaries of controlled geometry; (2) study of the fine structure of high angle boundaries with emphasis on the detection of relaxations into various fit-misfit structures; (3) structure of low angle grain boundaries; (4) faceting and the preferred crystal orientation of grain boundaries; (5) grain boundaries as sinks for point defects; and (6) diffusion along grain boundaries.
ERA

**N77-19904#** Brookhaven National Lab., Upton, N.Y.
**COMPUTER SIMULATION OF THE THERMAL PRESSURE IN SOLIDS AND THE EQUATION OF STATE**
D. O. Welch, G. J. Dienes, and A. Paskin 1976 11 p refs Presented at Conf. on Computer Simulation for Mater. Appl., Gaithersburg, Md., 19 Apr. 1976 Sponsored in part by ERDA and the Army
(BNL-21319; Conf-760421-11) Avail: NTIS HC A02/MF A01

The equation of state of solids was investigated with molecular dynamics techniques by obtaining the pressure as a function of temperature over a wide range of compressions. Data were obtained for fee crystals with Lennard-Jones interactions and for bee crystals with Morse interactions. The results were analyzed in terms of the Mie-Gruneisen equation of state. The Gruneisen constant at zero temperature is found to be essentially that obtained from the volume dependence of the mean-squared lattice vibration frequency, and its temperature dependence is approximated well with a self-consistent cell model. Calculated results are compared with experimental data for argon along the melting line.
ERA

**N77-19905#** Brown Univ., Providence, R. I.
**MODELS OF SLOW INTERGRANULAR VOID GROWTH DUE TO VOID SURFACE AND GRAIN BOUNDARY SELF-DIFFUSION M.S. Thesis**
Keith Isamu Kagawa Feb. 1976 61 p refs
(Contract E(11-1)-3084)
(COO-3084-42) Avail: NTIS HC A04/MF01

Intergranular void growth at elevated temperature is considered in cases for which the shape of the void is determined by void surface diffusion and growth occurs by diffusion from the void tip and along the grain boundary. A similarity solution for void shape is derived, along with an iterative solution for void shape. By assuming the grain boundary flux to be distributed in such a manner that the grains separate as rigid bodies, the similarity and iterative shapes are linked to the applied stress, and the resulting growth models compared with the limiting cases of equilibrium and crack-like growth. The comparison indicates that void growth can be represented by a two-part solution. An analysis is included of relaxation times associated with a variety of diffusion mechanisms which are useful in determining the dominant mechanisms of matter transport. ERA

**N77-19906#** California Univ., Berkeley. Lawrence Berkeley Lab.
**CHARACTERIZATION OF HETROGENEOUSLY NUCLEATED PHASE TRANSFORMATIONS AND CHARACTERIZATION OF ASSOCIATED MICROSTRUCTURES**
John Espinozz Sanchez, Jr. Jun. 1976 51 p refs
(Contract W-7405-eng-48)
(LBL-5161) Avail: NTIS HC A04/MF A01

Homogeneous and grain boundary heterogeneous nucleation and growth phase transformation processes have been shown to follow four distinct types of kinetic behavior. Kinetics are determined by processing treatment, interfacial and grain boundary energies, thermodynamic driving forces, and grain size. Under simple assumptions the four kinetic processes for phase transformation produce four distinct product microstructure types, the Johnson-Mehl, boundary saturated, edge saturated, and corner saturated microstructures.
ERA

**N77-19907#** Brookhaven National Lab., Upton, N.Y.
**STRUCTURAL STUDIES OF ORDER, DISORDER AND STOICHIOMETRY IN SOME HIGH T/SUB c/Nb-BASE A-15 SUPERCONDUCTORS**
D. E. Cox, S. Moehlecke, A. R. Sweedler, L. R. Newkirk (LASL), and F. A. Valencia (LASL) 1976 38 p refs Presented at 2nd Conf. on Superconductivity, Rochester, N. Y., 19 May 1976
(Contract E(30-1)-16)
(BNL-21505; Conf-760543-1) Avail: NTIS HC A03/MF A01

X-ray intensity measurements were made on several Nb-base A-15 type superconductors. Order parameters were determined with reasonable accuracy even in the presence of substantial amounts of impurity phases. Chemically vapor deposited Nb3Ge of near-stoichiometric composition is characterized by a significant amount of disorder, corresponding to occupation of about 4 percent of the Nb sites by Ge. Annealing at 1350 C converts this material to a Nb-rich A-15 phase and Nb5Ge3. The former has essentially no Ge on Nb sites. From the lattice parameter trends in these compounds and the A-15 region of the Nb-Pt system, a B site radius of 1.43A for Nb is proposed. This is significantly different from the A site radius of 1.51A and closer to the normal metallic twelve-coordinated value.

**N77-19908#** Los Alamos Scientific Lab., N.Mex.
**VOID GROWTH SUPPRESSION BY DISLOCATION IMPURITY ATMOSPHERES**
Johannes Weertman and Walter V. Green 1976 26 p refs Presented at the 8th ASTM Symp. on the Effect of Radiation on Structural Mater., St. Louis, 4 May 1976
(Contract W-7405-eng-36)
(LA-UR-75-2353; Conf-760515-1) Avail: NTIS HC A03/MF A01

A detailed calculation is given of the effect of an impurity atmosphere on void growth under irradiation damage conditions. Norris proposed that such an atmosphere can suppress void growth. The hydrostatic stress field of a dislocation that is surrounded by an impurity atmosphere was found and used to calculate the change in the effective radius of a dislocation line as a sink for interstitials and vacancies. The calculation of the impurity concentration in a Cottrell cloud takes into account the change in hydrostatic pressure produced by the presence of the cloud itself. It is found that void growth is eliminated whenever dislocations are surrounded by a condensed atmosphere of either oversized substitutional impurity atoms or interstitial impurity atoms. A condensed atmosphere will form whenever the average impurity concentration is larger than a critical concentration.
ERA

**N77-19909#** Los Alamos Scientific Lab., N.Mex.
**FABRICATION OF SUPERCONDUCTORS**
W. C. Turner, L. B. Lundberg, B. Zeitlin (Intermagnetics General Corp.), T. A. DeWinter (Magnetic Corp. of Am., Waltham, Mass.), and W. K. McDonald (Teledyne Wah Chang) 1976 15 p Presented at 6th ICED Meeting, Grenoble, France, 11 May 1976
(Contract W-7405-eng-36)

(LA-UR-76-360; Conf-760508-1) Avail: NTIS HC A02/MF A01

The development of a process for making high performance, fine filament superconducting wires, utilizing dual matrix stabilization and Nb46Ti superconducting filaments is discussed. Minimum filament size achieved was 8 microns using copper and Cu30Ni matrix materials. Ductility of the NbTi starting material was found to exert a major influence on the properties of the finished wire, and specifications for acceptable NbTi were developed. When specific impurity levels are exceeded, micron size precipitates and large inclusions are found. A rigorous stacking and extrusion procedure was developed. Very high density billets for extrusion were obtained by such techniques as co-drawing the stacking elements, contouring shells on a gear shaper, and hydrostatic compaction. Extrusion parameters discussed are reduction ratios, temperatures, and working speeds.

(Author) ERA

**N77-19910#** Oak Ridge National Lab., Tenn. Magnetics and Superconductivity Section.

**PROPAGATION OF NORMAL ZONES IN COMPOSITE SUPERCONDUCTORS**

Lawrence Dresner Aug. 1976 32 p refs Submitted for publication

(Contract W-7405-eng-26)

(ORNL-TM-5543) Avail: NTIS HC A03/MF A01

Calculations of propagation velocities of normal zones in composite superconductors are described. Full accounting is made for (1) current sharing; (2) the variation with temperature of the thermal conductivity of the copper matrix, and the specific heats of the matrix and the superconductor; and (3) the variation with temperature of the steady-state heat transfer at a copper-helium interface in the nucleate-boiling, transition, and film-boiling ranges. The theory, which contains no adjustable parameters, is compared with experiments on bare (uninsulated) conductors. Agreement is not good. It is concluded that the effects of transient heat transfer may need to be included in the theory to improve agreement with experiment. ERA

**N77-19911#** State Univ. of New York, Stony Brook. Dept. of Materials Science.

**APPLICATIONS OF MICRODYNAMICS AND LATTICE MECHANICS TO PROBLEMS IN PLASTIC FLOW AND FRACTURE Progress Report, 1 Jan. - 31 Dec. 1975**

John C. Bilello and J. M. Liu 1976 21 p refs

(Contract AT(11-1)-3476)

(COO-3476-12) Avail: NTIS HC A02/MF A01

The dynamical interaction of a propagating crack with twinning and slip in W and Mo crystals was measured. From static experiments, the effective radius of curvature at a crack tip and the local stress concentrations were determined, showing that the actual surface energy of Mo and W crystals is 50 percent smaller than previously considered. Work has also progressed on studies of interstitial impurity interactions where observations have been made on dislocation mobility, pinning energy, and pinning point separation by correlating etch-pit measurements with microstrain observations. Results show that oxygen has a binding energy approximately 0.05 eV to edge-dislocations in Mo and that lowering the oxygen concentration to a few ppM increases the dislocation velocity by approximately one order of magnitude when compared to less pure single pass EBZR crystals with 150 ppM total interstitials. ERA

**N77-19912#** Massachusetts Inst. of Tech., Cambridge. Dept. of Physics.

**TECHNOLOGY AND PHYSICS OF INFRARED AND POINT CONTACT DIODES Semiannual Technical Report, 1 Nov. 1975 - 30 Apr. 1976**

Ali Javan 9 Jun. 1976 19 p

(Contract F19628-74-C-0182; ARPA Order 2618; AF Proj. 2001)

(AD-A029451; RADC-TR-76-234; SATR-4) Avail: NTIS HC A02/MF A01 CSCL 20/12

A tube and mirrors have been installed from the argon and dye laser room to the diode testing area. Additional lead on aluminum diodes were evaluated at liquid helium temperature. An oxidation study was conducted on nickel which demonstrated that 400 square micrometer junctions from 100 ohms through 1 megohm can be made. Real time V-band and 337 micrometer holographic receptors have been designed and masks are being fabricated. Measurements are in progress on MOM (tungsten on nickel) point contact diodes to evaluate their effective antenna resistance as a function of length. The effective diode resistant is varied by changing whisker pressure and response is maximized with respect to whisker orientation in the focused laser beam. GRA

**N77-19913#** American Univ., Washington, D.C. Dept. of Physics.

**RARE EARTH-TRANSITION METAL MAGNETOSTRICTIVE MATERIALS Progress Report**

Jul. 1976 35 p refs

(Contract N00014-75-C-0736; NR Proj. 318-023)

(AD-A030791) Avail: NTIS HC A03/MF A01 CSCL 20/3

There are three basic models of an amorphous ferromagnet. Gubanov suggested very early that the amorphous ferromagnet is characterized by a distribution of exchange interactions. This plausible assumption has been pursued by a number of groups. Another view is that the exchange is uniform, but that the large single ion anisotropy is distributed uniformly in directions of easy axis over the unit sphere. Still a third approach, the collective electron model, is one we introduced and continue to work on. It is probably the right model for amorphous nickel, an intinerant ferromagnet in its crystalline phase, but is surely not descriptive of the rare earths. For the rare earth alloys neither the exchange nor the crystal field models have been carried to such agreement with experiment as to exclude the other from consideration, and there may be room for the both models in describing different materials. The quadrupole splitting in an amorphous material is the same as it is in the crystalling phase. GRA

**N77-19914#** Harry Diamond Labs., Adelphi, Md.

**PERMANENT AND TRANSIENT RADIATION EFFECTS ON THIN-OXIDE (200-A) MOS TRANSISTORS**

Stewart Share and Robert A. Martin Jun. 1976 25 p refs (DA Proj. 1T1-61102-AH-44)

(AD-A030968; HDL-TR-1745) Avail: NTIS HC A02/MF A01 CSCL 09/1

An approach for hardening metal oxide semiconductor (MOS) transistors to ionizing radiation by reducing the thickness of the gate oxide is presented. It is shown that Si gate, n-channel MOS field-effect transistors with oxides 200 A thick continue to operate in the enhancement mode after irradiation to 1,000,000 rads (Si) with a positive bias applied to the gate during the irradiation. This represents a considerable improvement over conventional thick-oxide (approximately 1,000-A) devices, which go into the depletion mode of operation at 100,000 rads (Si). The thin-oxide devices after exposure to pulsed ionizing radiation showed improved performance over that of thick-oxide devices. It was found also that device operation following irradiation depended on the source-drain spacing (channel length): Shortening the channel length leads to an increased shift of the threshold voltage induced by irradiation. Author (GRA)

**N77-19915#** University Coll., Cork (Ireland).

**ENERGY MIGRATION INVOLVING IRRADIATED SOLIDS Final Report, 1 Apr. 1971 - 31 Mar. 1976**

Joseph Cunningham Apr. 1976 58 p refs

(Contract AF-AFOSR-2148-71; AF Proj. 9538)

(AD-A030934; AFOSR-76-1108TR) Avail: NTIS HC A04/MF A01 CSCL 07/4

Migration of energy from irradiated semiconducting solids to acceptor molecules in contact with the solid surface has been experimentally examined, and models have been developed to account for the extent-of-reaction, kinetics and selectivity observed. Fast-detection techniques have been developed to follow, on a time-scale of milliseconds, the kinetics of 'fast' processes initiated at semiconducting metal oxide surfaces by UV-illumination, and studies included examination of interfaces between Metal Oxides and Aqueous Electrolytes by ESR, plus the study of Metal Oxide/GAS interfaces by a Dynamic Mass Spectrometric technique. Very low quantum efficiencies were measured for photoassisted processes involving adsorption, desorption or reaction of gases at the flash-illuminated surfaces. Author (GRA)

**N77-19916#** Princeton Univ., N.J. Solid State and Materials Lab.
**THE STABILITY OF DIELECTRIC COATINGS UNDER RADIATION Final Report, 1 Oct. 1974 - 31 Mar. 1976**
B. S. H. Royce and S. T. Wang 31 Mar. 1976 31 p refs
(Contract N00014-75-C-1022; DNA Proj. NWED-QAXTA007)
(AD-A030670; PSSL-160676; Rept-1288-AMS) Avail: NTIS HC A03/MF A01 CSCL 09/5

Research performed was directed at understanding the effects of ion implantation on the radiation hardness of the SiO2 gate oxide of MOS devices. MOS capacitors were used as test structures and capacitance-voltage measurements were combined with photoinjection, photodepopulation, thermal annealing and variable temperature measurements on both implanted and unimplanted samples in order that the modified oxide charge trapping could be probed. Some measurements were made using the scanning electron microscope as a source of electrons of controlled energy. C-V and G-V data was taken with the MOS samples in the microscope environment, the beam energy being slowly increased to probe the oxide to increasing depths. The experimental data indicate that the primary effect of the implantation process is to produce electron traps associated with the implantation induced displacement damage. At room temperature, electrons in these traps can charge compensate holes trapped near the Si/SiO2 interface. At low temperatures however, the increased hole trapping at this interface overcomes the effects of the trapped electrons and dominates the flat band voltage shifts. A model of the charge trapping behavior has been developed which satisfactorily explains the observed behavior. Author (GRA)

**N77-19917#** Arizona State Univ., Tempe. Dept. of Physics.
**SEM IMAGING OF CRYSTAL SURFACES USING DIFFRACTED BEAMS**
J. D. Landry, G. G. Hembree, P. E. Hojlund Nielsen, and J. M. Cowley 1976 10 p refs Presented at the 9th Ann. Scanning Electron Microscope Symp., Chicago, Apr. 1976
(Grant AF-AFOSR-1996-71; AF Proj. 9761)
(AD-A029925; AFOSR-76-0939TR) Avail: NTIS HC A02/MF A01 CSCL 20/2

Additional information regarding the structure of the surfaces of crystals may be obtained by the use of diffracted beams to form SEM images. Variations of diffracted beam intensities are produced both by surface topography and also by variations in the orientation or composition of the crystal. Image intensities are therefore sensitive indicators of chemical reactions, impurities, crystal imperfections or crystal distortion. A medium energy diffraction-SEM system with an ultra-high vacuum specimen environment has been built and used to demonstrate these possibilities (Cowley, et. al., Rev. Sci. Instr 46. 1975, 826-29). This instrument has been applied to the study of the structures of various crystal surfaces. A new surface phase observed to grow on oxidized copper single crystals at about 500 C is attributed to the precipitation of dissolved silver. For a mosaic crystal of pyrolytic graphite diffraction images show clearly the mosaic structure and the presence of crystal defects and allow interpretation of electron channeling effects observed in secondary electron images. Author (GRA)

**N77-19918#** Naval Research Lab., Washington, D.C.
**A FORTRAN SUBROUTINE TO EVALUATE THE TRANSPORT INTEGRALS J2(X) THROUGH J7(X) Final Report**
D. J. Gillespie Aug. 1976 12 p refs
(NRL Proj. M01-10; RR0220146)
(AD-A030219; NRL-MR-3346) Avail: NTIS HC A02/MF A01 CSCL 20/3

A computer program (in FORTRAN) has been written for evaluating the transport integrals J sub 2(x) through J sub 7(x) to approximately 6 significant figures. These integrals are often used in models describing such properties of solids as the electrical and thermal resistivity, thermoelectric power, and specific heat. GRA

# 77 THERMODYNAMICS AND STATISTICAL PHYSICS

Includes quantum mechanics; and Bose and Fermi statistics.

For related information see also *25 Inorganic and Physical Chemistry* and *34 Fluid Mechanics and Heat Transfer.*

**N77-19919#** California Univ., Livermore. Lawrence Livermore Lab.
**SELECTED TOPICS FROM CONTINUUM MECHANICS**
John W. White 9 Jul. 1976 25 p refs
(Contract W-7405-eng-48)
(UCID-17185) Avail: NTIS HC A02/MF A01

An attempt is made to provide a simple, nonrigorous introduction to some of the basic concepts and vocabulary of continuum mechanics. Some fundamental equations and physical facts are presented without significant derivation. The treatment is not comprehensive, but a number of references are given which can serve as starting points for study in greater depth. The subjects treated are elastic solids, material failure, gases and shock waves, liquids, instabilities, and detonation propagation. The equation of state is emphasized. ERA

**N77-19920#** Texas Univ., Austin. Center for Particle Theory.
**ZENO'S PARADOX IN QUANTUM THEORY**
B. Misra and E. C. G. Sudarshan Jul. 1976 20 p refs
(Contract E(40-1)-3992)
(ORO-3992-271) Avail: NTIS HC A02/MF A01

A quantum-theoretic expression is sought for the probability that an unstable particle prepared initially in a well-defined state will be found to decay sometime during a given interval. A simple natural approach to this problem leads to the startling conclusion that an unstable particle which is continuously observed whether it decays will never be found to decay. Since recording the track of an unstable particle realizes such continuous observations to a close degree of approximation, the above conclusion poses a paradox which is called Zeno's Paradox in Quantum Theory. Its implications and possible resolutions are briefly discussed. The mathematical transcription of the above-mentioned conclusion is a structure theorem concerning semigroups. Although special cases of this theorem are known, the general formulation and the proof given here are believed to be new. The known no-go theorem concerning the semigroup law for the reduced evolution of any physical system is subsumed under the theorem as a direct corollary. ERA

**N77-19921#** Maryland Univ., College Park. Dept. of Physics and Astronomy.
**EVOLUTION OF A QUANTUM SYSTEM: LIFETIME OF A DETERMINANT**
Peter C. Lichtner (Mainz Univ.) and James J. Griffin Jun. 1976 13 p refs Sponsored in part by Bundesmin. fuer Forsch. und Tech.
(Contract E(40-1)-4856)
(ORO-4856-57; TR-76-123; PP-76-280) Avail: NTIS HC A02/MF A01

A measure of the dependency of a many-particle system is defined, and its time dependence is evaluated for systems initially described by a single Slater determinant. An uncertainty product between the energy spread of the initial determinant and the lifetime of a system's independence is established. Numerical estimates of some lifetimes are given. They are not so long as to be reassuring for nuclear time-dependent Hartree-Fock calculations. Each separate case ought to be checked. ERA

**N77-19922#** National Bureau of Standards, Washington, D.C. Physical Chemistry Div.
**A COMBINED LEAST SUMS AND LEAST SQUARES APPROACH TO THE EVALUATION OF THERMODYNAMIC DATA NETWORKS Interim Report**
D. Garvin, V. B. Parker, D. D. Wagman, and W. H. Evans Jul. 1976 41 p refs
(PB-259637/7; NBSIR-76-1147) Avail: NTIS HC A03/MF A01 CSCL 07D

A system for computer-based evaluation of interrelated

thermodynamic measurements of enthalpies of reaction, equilibria and entropies is described. Linear least sums and least squares techniques are used to solve networks of thermodynamic equations to obtain the enthalpies and free energies of formation and the entropies of chemical substances. The least sums technique is shown to be useful in assessing the consistency of the data. A method combining least sums and least squares solutions, provides a weighted solution that reproduces closely the solutions that are obtained by a detailed analysis of the data using the customary sequential procedure. The results from tests on four large networks involving compounds of B, U, Rb and salts of Sn, Pb, Cd and Hg are discussed. GRA

# 80 SOCIAL SCIENCES (GENERAL)

Includes educational matters.

**N77-19923*#** New Mexico State Univ., Las Cruces.
**NASA SYMPOSIUM 76**
1976 200 p Symp. on Aeronautics and Space Technology held at Las Cruces, N. Mex., 21-23 Apr. 1976
(Contract NASw-2928)
(NASA-CR-149801) Avail: NTIS HC A09/MF A01 CSCL 05B

New Mexico State University and the National Aeronautics and Space Administration hosted a symposium to promote NASA's efforts to increase the available pool of minority and women scientists and engineers to meet affirmative hiring goals. The conferences also provided an opportunity for key NASA officials to meet with appropriate officials of participating institutions to stimulate greater academic interest (among professors and students) in NASA's research and development programs. Minority aerospace scientists and engineers had opportunity to interact with the minority community, particulary with young people at the junior high, high school, and college levels. One aim was to raise minority community's level of understanding regarding NASA's Regional Distribution System for storage and retrieval of scientific and technical information. Author

# 81 ADMINISTRATION AND MANAGEMENT

Includes management planning and research.

**N77-19924#** Army Logistics Management Center, Philadelphia, Pa.
**FORECASTING OF SECONDARY ITEM RETURNS Final Report**
Richard M. A. Urbach Aug. 1976 25 p ref
(AD-A030343; IRO-243) Avail: NTIS HC A02/MF A01 CSCL 15/5

A family of Return Rate models using a Kalman Filter to estimate unserviceable returns per unit of program (Flying Hours or Item Density) is examined. A comparison--based on several measures of forecast error--is made with the current forecasting model of unserviceable returns per unit of demand. The current model produces forecast errors 10 to 20 percent higher than the Kalman Filter models. GRA

**N77-19107*#** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**STOCHASTIC MODELS FOR SOFTWARE PROJECT MANAGEMENT**
R. C. Tausworthe *In its* The Deep Space Network 15 Feb. 1977 p 118-126 ref (For primary document see N77-19091 10-12)
Avail: NTIS HC A13/MF A01 CSCL 05A

# 82 DOCUMENTATION AND INFORMATION SCIENCE

Includes information storage and retrieval technology; micrography; and library science.

For computer documentation see *61 Computer Programming and Software*.

**N77-19925#** Office of Technology Assessment, Washington, D.C.
**AN ASSESSMENT OF INFORMATION SYSTEMS CAPABILITIES REQUIRED TO SUPPORT US MATERIALS POLICY DECISIONS**
Dec. 1976 261 p refs
(OTA-M-40; LC-76-600077) Avail: SOD HC $3.25

The adequacy of present information systems for the technology of materials supply, processing and uses is assessed to determine what institutional adjustments are needed in the nation to provide coordinated strategic economic information and to permit analysis of economic needs for resources, commodities, materials, and manufactured products on a permanent basis. A.H.

**N77-19926#** California Univ., Livermore. Lawrence Livermore Lab.
**EXTENDABLE INFORMATION FORMATS**
James E. Donnelley 12 May 1976 5 p refs Presented at the Workshop on Distributed Data Management, Berkeley, Calif., 25 May 1976
(Contract W-7405-eng-48)
(UCRL-78211; Conf-760550-1) Avail: NTIS HC A02/MF A01

Information formats can often be adapted for use by processes different than those for which they were initially designed. The extent to which a format can be so adapted without semantic modification is a measure of its extendability. There are many information formats used today in communication protocols, data storage structures, etc., that are severely limited in scope because of their lack of extendability. By examining some of these formats and determining modifications which can make them more extendable, a set of design principles can be extracted which may be used to generate more extendable formats. ERA

**N77-19927#** California Univ., Berkeley. Lawrence Berkeley Lab.
**CONCISE GUIDE TO TWO ONLINE BIBLIOGRAPHIC SEARCH SERVICE SYSTEMS**
Harriet W. Zais May 1976 66 p
(Contract W-7405-eng-48)
(LBL-4835) Avail: NTIS HC A04/MF A01

A guide is given to the bibliographic data bases offered by Lockheed Information Systems and System Development Corporation Search Service for online information searching. The following information is provided in table form for each of 48 data bases: hours the data base is available for online searching; beginning date of the computer-readable file; file size; frequency of file update; presence or absence of an abstract in the machine-readable citation; computer connect charges and off-line print charges; and additional features, search aids, or notes on the data base. General information on the vendors' services (equipment requirements, manuals and training, system features, costs) is presented along with a brief overview of online searching. An index by acronym or data base name is provided. The report updates and supercedes UCID-3656, A Comparison of Three Online Information Retrieval Systems (April 1974). ERA

**N77-19928#** Oak Ridge National Lab., Tenn.
**BIOMEDICAL COMPUTING TECHNOLOGY INFORMATION CENTER: INTRODUCTION AND REPORT OF EARLY PROGRESS**
Betty F. Maskewitz, R. L. Henne, and W. J. McClain 1976 8 p refs Presented at Southeast Region MUMPS User's Meeting, Atlanta, 28 May 1976 Sponsored by ERDA
(CONF-760555-1) Avail: NTIS HC A02/MF A01

The Biomedical Computing Technology Information Center (BCTIC) collects, organizes, evaluates, and disseminates information on computing technology pertinent to biomedicine, providing

needed routes of communication between installations and serving as a clearinghouse for the exchange of biomedical computing software, data, and interface designs. BCTIC's functions and early progress to the MUMPS Users' Group is presented in order to stimulate further discussion and cooperation between the two organizations. ERA

**N77-19929#** Oak Ridge National Lab., Tenn.
**INFORMATION CENTER AS A TECHNICAL INSTITUTE UNIFYING A USER COMMUNITY**
Betty F. Maskewitz, Betty McGill, and Nancy A. Hatmaker 1976 13 p refs Presented at 5th Mid-year Meeting of Am. Soc. for Inform. Sci., Nashville, 20-22 May 1976 Sponsored by ERDA
(CONF-760510-1) Avail: NTIS HC A02/MF A01

The historical background to the information analysis center concept is presented. The Radiation Shielding Information Center (RSIC) at ORNL is cited as an example of the information analysis center. RSIC objectives and scope are described, and RSIC's role in unification of the field of shielding is discussed. Some problems in handling information exchange with respect to computer codes are examined. Author (ERA)

**N77-19930#** California Univ., Livermore. Lawrence Livermore Lab.
**LABORATORY DATA MANAGEMENT FOR THE ENVIRONMENTAL PROTECTION AGENCY**
Henry S. Ames 15 Apr. 1976 65 p refs
(Contract W-7405-eng-48)
(UCRL-52054) Avail: NTIS HC A04/MF A01

The requirements of a data management system for handling the data from samples in a realtime laboratory environment, specifically the analytical data in EPA laboratories is presented. The implementation of this sample file controller is discussed, both as a file management system and as a data base management system. Three prototype designs are presented (single-CPU file management, and single- and dual-CPU data base management) and compared in terms of flexibility hardware requirements, and response time; they involve multiple users, the BASIC language, and Data General minicomputers. ERA

**N77-19931#** Naval Training Analysis and Evaluation Group, Orlando, Fla.
**AN EVALUATION OF MICROFICHE READER TYPES FOR USE WITH PROGRAMMED INSTRUCTION. PHASE 1 Technical Report, Mar. - Aug. 1976**
F. Laurence Keeler and William A. Rizzo Aug. 1976 38 p refs
(AD-A029714; TAEG-35) Avail: NTIS HC A03/MF A01 CSCL 14/5

This is the first phase of a four-phase study in the application of the microfiche medium for onboard training systems. This phase evaluates a cross-section of microfiche readers with respect to their ease-of-use by Navy enlisted personnel in loading/unloading microfiche and branching to specified microfiche frames. Sixty Navy recruits performed a microfiche branching task to simulate the branching requirements of programmed instruction. Five microfiche indexing methods, using four types of readers, were rank-ordered in ease-of-use using times required to load/unload microfiche and complete a tracking on 16 microfiche. It was found that the typical Navy recruit can, with a minimum of instruction, use any of a cross-section of microfiche readers. The realist/Vantage I reader with the grid map index was rated the most efficient, and this type of reader/indexing system was recommended for use in Navy training. Author (GRA)

**N77-19932#** Environmental Protection Agency, Washington, D.C. Library Systems Branch.
**STATE AND LOCAL ENVIRONMENTAL LIBRARIES: A DIRECTORY. SECOND EDITION**
Nov. 1976 31 p Prepared in cooperation with NOAA, Rockville, Md.
(PB-259918/1; EPA-LIB-76-02) Avail: NTIS HC A03/MF A01 CSCL 05B

An updated directory of state and local environmental libraries is presented. Neither general university libraries nor documents divisions of these and public libraries were included, because the primary portions of such collections are not presumed to be environmentally oriented. Specialized departmental libraries of both university and public libraries are listed where they specifically relate to environmental activities. GRA

**N77-19005#** Advisory Group for Aerospace Research and Development, Paris (France).
**A BIBLIOGRAPHY OF SELECTED LITERATURE PUBLISHED BETWEEN 1973 AND 1976 WITH EMPHASIS ON EXPERIMENTAL STUDIES**
*In its* Aerodynamic Noise, Jan. 1977 46 p refs (For primary document see N77-18994 10-01)
Avail: NTIS HC A14/MF A01

## 83 ECONOMICS AND COST ANALYSIS

Includes cost effectiveness studies.

**N77-19933#** California Univ., Berkeley. Lawrence Berkeley Lab.
**ECONOMIC MODELING: AN AID TO THE PRICING OF INFORMATION SERVICES**
Harriet W. Zais Aug. 1976 16 p refs Presented at the Ann. Meeting of the Am. Soc. for Inform. Sci., San Francisco, 5 Oct. 1976
(Contract W-7405-eng-48)
(LBL-4899; Conf-761011-3) Avail: NTIS HC A02/MF A01

Components of the pricing decision are identified: the pricing objectives pursued, the pricing policies these aims are translated into, and the actual pricing methods employed in calculating what price to charge. Several of the pricing practices are described using a basic classification scheme developed for the field of marketing: cost-oriented, competition-oriented, and demand-oriented approaches to pricing. Costs represent a starting point for developing pricing structure, and cost-oriented pricing techniques are taken up in detail. Cost functions are identified, and their impact on price setting is suggested. Examples and data are provided from recent research into the pricing of computer-assisted selective dissemination of information services. The techniques of price discrimination, marginal cost pricing, and break-even analysis are discussed. ERA

## 84 LAW AND POLITICAL SCIENCE

Includes space law; international law; international cooperation; and patent policy.

No abstracts in this category.

## 85 URBAN TECHNOLOGY AND TRANSPORTATION

Includes applications of space technology to urban problems; technology transfer; technology assessment; and surface and mass transportation.

For related information see *03 Air Transportation and Safety*, *16 Space Transportation*, and *44 Energy Production and Conversion*.

**N77-19934*#** Spectrix Corp., Houston, Tex.
**DEVELOPMENT OF WATER QUALITY STANDARDS CRITERIA Final Report, 27 Mar. 1975 - 31 Dec. 1976**
Dec. 1976 65 p
(Contract NAS9-14548)
(NASA-CR-151237) Avail: NTIS HC A04/MF A01 CSCL 06I

Qualitative and semiquantitative analyses were made of volatile organic compounds in water supplies collected at various stages of processing in the space station prototype vacuum compression distillation unit to evaluate the process and the

product water. Additional evaluation was made of specific ingredients required to adequately enhance the taste of the reclaimed water. A concept for the in-flight addition of these ingredients was developed. Revisions to previously recommended potable water criteria and specifications are included. Author

**N77-19935#** Oak Ridge National Lab., Tenn. Solid State Div.

**PRACTICAL REASONS FOR INVESTIGATING ION TRANSPORT IN HIGH TEMPERATURE INSULATING MATERIALS**

E. Sonder Jul. 1976 24 p refs Presented at 2. Europhys. Topical Conf., Berlin, 30 Aug. 1976

(Contract W-7405-eng-26)

(CONF-760831-2) Avail: NTIS HC A02/MF A01

Practical problems encountered in a number of advanced technology applications, particularly those related to energy conversion, are discussed. Refractory ionic compounds which are abundant and of high melting point are listed, and technological problems are discussed in terms of specific materials problems. The argument is made that basic information concerning transport properties in refractory compounds is lacking to such an extent that it is difficult to design and assess advanced energy generation systems. Technology applications include; (1) ceramic nuclear fuels for high temperature fission reactors; (2) high temperature gas turbine blades; (3) insulators in controlled thermonuclear reactors, and (4) magnetohydrodynamic generators. Some of the difficulties inherent in making transport property measurements at high temperatures are also listed. ERA

**N77-19936#** Brookhaven National Lab., Upton, N.Y.

**FRESH WATER FROM SEWAGE ON LONG ISLAND**

Maxwell M. Small Apr. 1976 17 p refs Presented at Meeting of the Federated Garden Clubs, Hauppauge, N. Y., 27 Apr. 1976

(Contract E(30-1)-16)

(BNL-21371; Conf-760453-1) Avail: NTIS HC A02/MF A01

Small sewage purification systems adequate for about 250 homes are being tested for the return of drinking quality fresh water to the local water table. One system consists of a grass meadow which slopes into a planted marsh which merges into a pond which is stocked with fish. Sewage is applied at the top of the meadow and flows down the grassed area permeating the soil and grass roots; it then passes through the marsh soils and around the marsh plant stalks and roots and into the pond. The marsh and pond are maintained at a constant level by an overflow pipe. Fresh, drinkable water flows out of this pond overflow. The second system is simple having only a slightly larger marsh followed by the same size pond. Neither system produced any sludge or objectionable odors. Further research will concentrate on virus and pathogen removal efficiency. ERA

**N77-19937#** Sandia Labs., Albuquerque, N.Mex. Waste Management and Environmental Programs Dept.

**WASTE RESOURCES UTILIZATION PROGRAM Interim Report**

Jul. 1976 148 p refs

(Contracts AT(29-1)-789)

(SAND-76-0350) Avail: NTIS HC A07/MF A01

The effects of the combined use of heat and ionizing radiation (thermoradiation) as a treatment for ridding sewage sludge of pathogenic organisms as well as its effect on the physical-chemical properties are reported. This activity couples two major environmental problems, disposition of human and of nuclear waste, in an attempt to provide a framework in which both will become useful resources. Sludge treated with thermoradiation offers considerable potential for use as a fertilizer in agriculture or a soil conditioner for land reclamation free of the potential health hazards associated with conventional methods of land disposal. Treated sludge may also provide a low-cost substitute for high-nutritional components in ruminant diets. ERA

**N77-19938#** Societe Nationale Industrielle Aerospatiale, Cannes (France). Div. Systemes Balistiques et Spatiaux.

**SPACE TELESCOPE SOLAR ARRAY: FEASIBILITY STUDY Final Technical Report**

G. Barkats, C. Chenin, A. Guirard, M. Koedinger, G. LeGuilly, L. Leroy, J. Loup, L. Raisin, and R. Valli 1 Oct. 1976 49 p

(Contract ESTEC-2644/76-NL/PP(SC))

(Rept-367-CA/65; ESA-CR(P)-885) Avail: NTIS HC A03/MF A01

The principle of the technical solution adopted for the budgetary evaluation of a solar array for the space telescope is described. The feasibility study leading to this solution is concerned with a detailed analysis of the specifications imposed by the mission. The structure of the proposed solar array is of the deployable-foldable rigid type. The hinge-driving mechanisms are basically electric actuators controlled by an electronic sequencer onboard the telescope. The solar array consists mainly of flexible subnetworks integrated onto the structure. The adopted solar cells are high-performance 200 micron thick, 2 x 4 sq cm silicon cells. The selected solution is capable of meeting all specified requirements. The development plan provides a survey of all technological and element/assembly level tests needed in the production of such a solar array. Author (ESA)

**N77-19939#** Environmental Protection Agency, Cincinnati, Ohio. Office of Technology Transfer.

**LAND TREATMENT OF MUNCIPAL WASTEWATER EFFLUENTS. DESIGN FACTORS, VOLUME 1**

Jan. 1976 51 p refs 3 Vol.

(PB-259995/9; EPA-625/4-76-010-Vol-1) Avail: NTIS HC A04/MF A01; also avail. in set of 3 reports as PB-259994-SET, HC E99/MF E99 and also avail. from EPA, Cincinnati, Ohio. 45268 CSCL 02C

Land treatment or land application is the treatment of wastewater by using plant cover, soil surface, soil profile, and geologic materials to remove certain wastewater pollution. Topics discussed include: (1) the objectives of land application processes, (2) preapplication treatment, (3) land suitability, (4) selection of the land application process, (5) distribution techniques, (6) climatic factors, (7) storage, (8) surface runoff control, (9) public health considerations, and (10) monitoring requirements. GRA

**N77-19940#** Environmental Protection Agency, Cincinnati, Ohio. Office of Technology Transfer.

**LAND TREATMENT OF MUNCIPAL WASTEWATER EFFLUENTS. DESIGN FACTORS, VOLUME 2**

Jan. 1976 75 p refs 3 Vol.

(PB-259996/7; EPA-625/4-76-010-Vol-2) Avail: NTIS HC A04/MF A01; also avail. in set of 3 reports as PB-259994-SET, HC E99/MF E99 and also avail. from EPA, Cincinnati, Ohio. 45268 CSCL 02C

For abstract, see N77-19939.

**N77-19941#** Environmental Protection Agency, Cincinnati, Ohio. Office of Technology Transfer.

**LAND TREATMENT OF MUNCIPAL WASTEWATER EFFLUENTS. CASE HISTORIES, VOLUME 3**

Jan. 1976 81 p refs 3 Vol.

(PB-259997/5; EPA-625/4-76-010-Vol-3) Avail: NTIS HC A05/MF A01; also avail. in set of 3 reports as PB-259994-SET, HC E99/MF E99 CSCL 02C

Case histories of five properly managed systems of land application of municipal wastewater are presented. The design criteria and operation of each facility are described, as well as the soil characteristics and the monitoring schedules used to assess the chemical and biological parameters. The five facilities considered are: the Michigan State University Water Quality Management Project (WQMP); the City of Tallahassee Spray Irrigation Project (TSIP); the Flushing Meadows Project (FMP); the Pennsylvania State University Wastewater Renovation and Conservation Project (WRCP); and the City of Boulder Colorado Project (BCP). GRA

**N77-19942#** Mitre Corp., Bedford, Mass.

**RESOURCE RECOVERY PLANT IMPLEMENTATION: GUIDES FOR MUNICIPAL OFFICIALS, PROCUREMENT**

Alan Shilepsky 1976 73 p

(Contract EPA-68-01-2647)

(PB-259140/2; EPA/SW-157.5) Avail: NTIS HC A04/MF A01 CSCL 13B

A competitive negotiation approach to procurement of resource recovery systems and services is refined and explained. This approach offers flexibility and is appropriately used to procure not only equipment and facilities, but also a 'system designer'

whether a consulting engineer or a design and construct contractor. Topics that are treated in some detail are managing the procurement process, i.e., procedures for soliciting and evaluating proposals, and preparing the Request for Proposals. GRA

**N77-19943#** Environmental Protection Agency, Cincinnati, Ohio. Office of Solid Waste Management Programs.
**RESOURCE RECOVERY PLANT IMPLEMENTATION: GUIDES FOR MUNICIPAL OFFICIALS, MARKETS**
Yvonne M. Garbe and Steven J. Levy 1976 54 p refs Sponsored by EPA
(PB-259141/0; EPA/SW-157.3) Avail: NTIS HC A04/MF A01 CSCL 13B

Several materials and a variety of different energy products can potentially be recovered from municipal solid waste and sold to produce revenue. The markets for these energy and material products are discussed, focusing on those characteristics that effect marketability. Included are descriptions and locations of potential markets, the product quality required by those markets, and approximate market prices. Marketing techniques are addressed with directions for conducting a market research and obtaining purchase agreement. GRA

**N77-19944#** Environmental Protection Agency, Cincinnati, Ohio. Office of Solid Waste Management Programs.
**RESOURCE RECOVERY PLANT IMPLEMENTATION: GUIDES FOR MUNICIPAL OFFICIALS, RISKS AND CONTRACTS**
Robert E. Randol 1976 63 p refs
(PB-259142/8; EPA/SW-157.7) Avail: NTIS HC A04/MF A01 CSCL 13B

Guidelines are presented to aid states, municipalities, and private industry in their efforts to achieve fair and equitable agreements for the implementation of resource recovery systems. Contents include: resource recovery risks and contracts; risks in resource recovery; the effect of risks on contractual relationships: some case study experience; resource recovery risk allocations; and contracting for a resource recovery system: insights from three pioneering projects. GRA

**N77-19945#** Environmental Protection Agency, Cincinnati, Ohio. Office of Solid Waste Management Programs.
**RESOURCE RECOVERY PLANT IMPLEMENTATION: GUIDES FOR MUNICIPAL OFFICIALS, ACCOUNTING FORMAT**
David B. Sussman 1976 22 p Sponsored by EPA
(PB-259143/6; EPA/SW-157.6) Avail: NTIS HC A02/MF A01 CSCL 13B

The economics of various types of resource recovery systems are difficult to compare. System technologies vary, capital and operating costs vary, revenues from the recovered products vary, the recovered products themselves vary, and the cost accounting methods used to analyze system economics vary. This paper proposed a method of reporting costs and revenues to aid in comparing the costs of various resource recovery systems. The proposed method includes a standardized accounting format and a normalized accounting format. GRA

**N77-19946#** Environmental Protection Agency, Cincinnati, Ohio. Office of Solid Waste Management Programs.
**RESOURCE RECOVERY PLANT IMPLEMENTATION: GUIDES FOR MUNICIPAL OFFICIALS, TECHNOLOGIES**
Bob Lowe, Bob Holloway, David B. Sussman, and Yvonne M. Garbe 1976 86 p refs Sponsored by EPA
(PB-259144/4; EPA/SW-157.2) Avail: NTIS HC A05/MF A01 CSCL 13B

Techniques for converting mixed municipal waste into marketable products give municipal and regional officials a variety of new options for solving their solid waste management problems. Although these resource recovery systems cannot be expected to operate at a profit and although they will not allow a community to close down its landfill, the life of the landfill can be extended tremendously by the weight and volume reductions achieved. A technology review is presented to acquaint the reader with the available and emerging technology options for processing of mixed municipal waste for resource recovery. GRA

**N77-19947#** George Washington Univ., Washington, D.C. School of Engineering and Applied Science.
**COURSES ES 251-252-TRANSPORTATION, PROJECT E. TOPICS ON AIRPORT ACCESS IN THE WASHINGTON METROPOLITAN AREA, 1976**
Thomas Cooper, Donald Cuming, Robert Siftar, and Paul Stangas Apr. 1976 171 p refs Supersedes ES-251-52
(Grant NSF HES-72-07726)
(PB-258900/0; ES-251-252-E) Avail: NTIS HC A08/MF A01 CSCL 13B

Four articles concerned with planning and engineering concepts related to airport access are presented. The impact of the Washington National Airport Metro Stop on the entire system is analyzed. A staged recommendation for providing access to Dulles Airport, employing several modes is described. The state-of-the-art of rapid rail vehicles is surveyed and their applicability to airport access in the Washington Metropolitan Area examined. Three approaches for providing pedestrian access between National Airport Metro Stop and the Airport itself are discussed. Design parameters and costs of each component of the system are explored, and recommendations for staging are coordinated with estimated demand. GRA

**N77-19948#** BDM Corp., Vienna, Va.
**DECISION-RELATED RESEARCH ON TECHNOLOGY UTILIZED BY LOCAL GOVERNMENT. RESCUE OPERATIONS. VOLUME 1: RESEARCH, PHASE 1 Final Report**
J. H. Durfee, L. H. Charity, and M. G. Semmens 13 Aug. 1976 174 p 2 Vol.
(Contract NSF C-960)
(PB-259313/5; BDM/W-75-165-TR-Vol-1; NSF/RA-760226) Avail: NTIS HC A08/MF A01 CSCL 06G

Local government rescue operations are investigated to provide information for advanced research in equipment requirements and evaluation, and to permit cost effective procurement of rescue equipment by governments. A description of the methodologies employed for each of six tasks is given along with a systems overview of rescue operations. Research methodologies and results are included. GRA

**N77-19949#** BDM Corp., Vienna, Va.
**DECISION-RELATED RESEARCH ON TECHNOLOGY UTILIZED BY LOCAL GOVERNMENT. RESCUE OPERATIONS. VOLUME 2: APPENDICES, PHASE 1 Final Report**
J. H. Durfee, L. H. Charity, and M. G. Semmens 13 Aug. 1976 362 p refs 2 Vol.
(Contract NSF C-960)
(PB-259314/3; BDM/W-75-165-TR-Vol-2; NSF/RA-760227) Avail: NTIS HC A16/MF A01 CSCL 06G

Data gathered in phase 1 of rescue operations research is presented. Included are: (1) miscellaneous community and incident data; (2) rescue equipment data and expert evaluation matrices; (3) optimal extrication equipment packaging configuration; (4) life cycle cost data; (5) users requirements committee members; and (6) bibliography. GRA

**N77-19950#** Army Engineer Waterways Experiment Station, Vicksburg, Miss. Mobility and Environmental Systems Lab.
**POWERED WHEELS IN THE TURNED MODE OPERATING ON YIELDING SOILS Final Report Ph.D. Thesis - Okla. State Univ.**
Gary N. Durham Sep. 1976 193 p refs
(DA Proj. 1T1-61102-B-52A)
(AD-A030701; WES-TR-M-76-9) Avail: NTIS HC A09/MF A01 CSCL 13/6

This report summarizes research concerned with the performance of single, pneumatic-tired, powered wheels operating in the turned mode and the formulation of the findings with analytical relations and dynamical equations for predicting the performance of four wheeled vehicles operating on soft soils and negotiating a flat horizontal turn under ideal steady-state motion. Seventy-two single pass tests were conducted in the laboratory on a near saturated clay and an air-dry sand with a 6.00-9 tire. Wheel turn angles were 0, 5, 10, 15, and 20 deg; vertical wheel loads varied from 1,000 to 4,000 N; and tire deflections were 0.15, 0.25, and 0.35 of the undeflected tire section height. The clay was processed and placed at a soft

consistency having a cone penetration resistance of 290 kPa. Relative density of the air-dry sand ranged from loose to medium with corresponding cone penetration gradients of 2.0 and 3.2 MPa/m. Performance of the powered wheel was expressed in terms of pull force coefficient, side force coefficient, required input torque coefficient, sinkage coefficient, and wheel slip as influenced by the following independent variables: soil strength, tire deflection and geometry, wheel load, and wheel turn angle. GRA

**N77-19951#** Naval Civil Engineering Lab., Port Hueneme, Calif.
**SANITARY LANDFILL SIMULATION - TEST PARAMETERS AND A SIMULATOR CONCEPTUAL DESIGN Final Report, Jul. 1973 - Jun. 1975**
William V. Miller, Carter J. Ward, Richard A. Boeticher, and Norman P. Clarke Aug. 1976 47 p refs
(YF7572001)
(AD-A030998; CEL-TN-1451) Avail: NTIS HC A03/MF A01 CSCL 13/2

Specific physical characteristics of a typical solid waste landfill were selected based on their correlation with potential landfill design/operation procedural changes and their suitability in being monitored under varying conditions within a sanitary landfill simulator (SLS). Design requirements of and SLS were outlined relating to scaling, pressure, temperature, gas composition, operation, maintenance, instrumentation, and control. A conceptual design meeting these requirements was developed for laboratory equipment capable of simulating a section within a landfill representative of actual landfill conditions. The basic concept had a limited chamber temperature capability of 200 F; however, operation of a 1500 F chamber to support pyrolysis was considered. Author (GRA)

**N77-19952#** Michigan Univ., Ann Arbor. Wetlands Ecosystem Research Group.
**FRESHWATER WETLANDS AND SEWAGE EFFLUENT DISPOSAL**
D. L. Tilton, R. H. Kadlec, and C. J. Richardson May 1976 328 p refs Proc. of a Natl. Symp. held at Ann Arbor, 10-11 May 1976
(Grant NSF ENV-75-08855-A01)
(PB-259305/1; NSF/RA-760251) Avail: NTIS HC A15/MF A01 CSCL 13B

The feasibility of using freshwater wetland ecosystems to remove certain chemicals from secondarily treated wastewater before they enter lakes, streams, and groundwaters is discussed. The following represents a general list of those areas of consideration: (1) hydrology: fate of water beyond the wetlands, loading rate, flow rate within the wetland; (2) nutrient dynamics and accumulation: efficiency of treatment, mechanism of nutrient removal from wastewater, loading rate; (3) environmental impacts: changes in species composition, habitat protection, health; and (4) land use: compatible with other traditional uses of wetlands, policies associated with state and federal wetlands. GRA

**N77-19953#** Aerospace Corp., Los Angeles, Calif.
**CONTROL OF WASTE AND WATER POLLUTION FROM POWER PLANT FLUE GAS CLEANING SYSTEMS Annual Report, Jan. - Dec. 1975**
P. P. Leo and J. Rossoff Oct. 1976 176 p refs
(Contract EPA-68-02-1010)
(PB-259211/1; EPA-600/7-76-018; AR-1 ATR-76(7297-01)-2) Avail: NTIS HC A09/MF A01 CSCL 13B

The state of research and development in the fields of nonregenerable flue gas cleaning (FGC) waste treatment, utilization, and disposal is summarized, as well as water reuse technology, for coal-fired utility power plants. Significant results cover: (1) chemical and physical characterization of wastes from eastern and western U.S. plants using lime, limestone, or double-alkali scrubbing systems; (2) chemical and physical properties and leaching characteristics of treated and untreated wastes; (3) field evaluations of treated and untreated waste disposal; (4) disposal alternatives; (5) cost estimates for ponding and for fixation disposal methods; (6) disposal standards; and (7) potential use of wastes in fertilizer production and Portland cement manufacture. GRA

**N77-19954#** Federal Highway Administration, Washington, D.C. Implementation Div.
**TECHNOLOGY TRANSFER: A REPORT OF NEW IDEAS RECENTLY IMPLEMENTED BY HIGHWAY AGENCIES IN FHWA REGION 3 Final Report in Interviews, Oct. 1974 - Feb. 1975**
William C. Besselievre Apr. 1976 127 p refs Sponsored by DOT
(PB-259433/1; FHWA-RD-76-172) Avail: NTIS HC A07/MF A01 CSCL 13B

Listings of research already implemented or soon to be implemented by states in Region 3 are presented. Emphasis is placed on research results already implemented since it is known that the ideas are usable, and it is more likely that a highway agency will adopt an item already being used by another organization. Implemented research items are listed by state and are grouped into specific categories, such as pavement design and construction or traffic and safety. Items are identified by a descriptive title accompanied by the name and phone number of an individual familiar with the implementation, and a short narrative. GRA

**N77-19955#** South Dakota State Univ., Brookings. Water Resources Inst.
**INFILTRATION LAGOONS FOR TERTIARY TREATMENT OF STABILIZATION POND EFFLUENT**
James N. Dornbush Mar. 1976 45 p refs
(Contract DI-14-31-0001-5042)
(PB-259473/7; W77-00540; OWRT-A-044-SDAK(1)) Avail: NTIS HC A03/MF A01

Infiltration lagoons were designed and operated to make maximum use of an in-place soil system to provide advanced treatment of stabilization pond effluents in order to meet future effluent standards. Preliminary lysimeter studies demonstrated that a high degree of treament was provided by soil filtration although infiltration rates were too low to be practical for a full-scale operation. Scarified pilot infiltration-percolation basins, operated with weekly applications of 18 and 24 inches of stabilization pond effluent were able to maintain infiltration rates in excess of 0.5 inches per hour throughout the summer. GRA

**N77-19956#** Tennessee Valley Authority, Chattanooga.
**STUDY OF THE FEASIBILITY OF A REGIONAL SOLID WASTE DERIVED FUEL SYSTEM IN THE TENNESSEE VALLEY AUTHORITY SERVICE AREA**
Jul. 1976 229 p refs
(Contracts EPA-IAG-D5-0819; FEA-CC-04-50063-00)
(PB-259764/9; PRS-8; FEA/G-76/460) Avail: NTIS HC A11/MF A01 CSCL 13B

The feasibility and economics of establishing a resource recovery system in the TVA region are evaluated. This system would consist of collecting, transporting and processing the municipal solid waste by burning the fuel fraction with coal in a conventional TVA power boiler modified for that purpose. Waste will be converted to a synthesis gas with subsequent conversion to fuel grade methanol for use in TVA's gas turbines modified to accept such a fuel. GRA

**N77-19957#** Battelle Pacific Northwest Labs., Richland, Wash. Dept. of Water and Land Resource.
**ASSESSMENT OF MATHEMATICAL MODELS FOR STORM AND COMBINED SEWER MANAGEMENT Final Report**
Albin Brandstetter Aug. 1976 523 p refs
(Contract EPA-68-03-0251)
(PB-259597/3; EPA-600/2-76-175A) Avail: NTIS HC A22/MF A01 CSCL 13B

Mathematical models for the nonsteady simulation of urban runoff were evaluated to determine their suitability for the engineering assessment, planning, design and control of storm and combined sewerage systems. The models were evaluated on the basis of information published by the model builders and model users. Seven models were also tested by computer runs using both hypothetical and real catchment data. Most of the models evaluated include the nonsteady simulation of the rainfall-runoff process and flow routing in sewers. GRA

**N77-19958#** Dynatrend, Inc., Burlington, Mass.
**TRANSPORTATION TECHNICAL ASSISTANCE NEEDS AND**

**REQUIREMENTS ANALYSIS Final Report, Jul. - Sep. 1976**
Peter A. Albin and Rudolph G. DiLuzio Sep. 1976 37 p refs (Contract DOT-OS-60500)
(PB-259680/7; DYN-UR-003; DOT-TST-76T-14) Avail: NTIS HC A03/MF A01 CSCL 13B

As part of the reevaluation of the priorities of transportation decision makers, the Office of R and D Policy (OST) has undertaken a study to determine the transportation technical assistance needs of the various user groups in the infrastructure. This determination was based on four independent studies: (1) TSC Technology Sharing surveys, (2) the report of the OBM Study Committee on Policy Management Assistance, (3) Urban Consortium for Technology Initiatives needs determination, and (4) the National Conference of State Legislatures survey. The analysis of these needs determinations was stratified to identify those needs peculiar to each of three user groups: (1) policy, (2) planning and evaluation, and (3) operations. The relationship of the needs to both the public management processes and Federal transportation policy is presented. GRA

**N77-19959#** Purdue Univ., Lafayette, Ind. Water Resources Research Center.
**EVALUATION OF ACTIVATED SLUDGE CONTROL TECHNIQUES THROUGH PILOT PLANT AND COMPUTER ANALYSES Final Report, Jul. 1974 - Jun. 1976**
Ralph E. Roper, Jr. and C. P. Leslie Grady, Jr. Jun. 1976 210 p refs Sponsored by Office of Water Res. and Technol.
(PB-258774/9; W77-00157; OWRT-A-033-IND(1); TR-77) Avail: NTIS HC A10/MF A01 CSCL 13B

An approach to activated sludge system control was developed and experimentally verified in which the key parameter is the sludge age or mean cell residence time. Central to this approach is the use of a hydraulic control formula which can be applied to a variety of control situations and can be made plant specific by a simple calibration technique. To supplement the control formula a system descriptive operational diagram was developed which superimposes the predictions from current models for activated sludge bio-oxidation, sludge thickening and oxygen transfer. The diagram allows the operator to visualize the system constraints so that the need for a control action is obvious. GRA

**N77-19960#** Urban Systems Research and Engineering, Inc., Cambridge, Mass.
**PLANNING AND INSTITUTIONAL CONSIDERATIONS IN WASTEWATER TREATMENT FACILITIES PLANNING, BOSTON, MASSACHUSETTS. PHASE 1 STUDY Final Report**
Clark Binkley, James Hudson, and Richard Tabors 16 Jul. 1976 211 p refs
(Contract EQ6AD451)
(PB-259576/7; EQ-517624451) Avail: NTIS HC A10/MF A01 CSCL 13B

A case study is presented of the effectiveness of planning for municipal waste-water treatment facilities construction grants under the FWPCA Amendments of 1972 (PL 92500) in order to identify problems and short-comings in the national program as currently administered. Phase 1 consisted of initial data collection and sharpening of issues for further research. Phase 2 is studying issues evaluated by Phase 1 contractors as warranting further consideration. This study covers planning and institutional considerations; one by Resource Analysis covers water quality considerations; there are also two NSF-contracted studies in Phase 1. GRA

## 88 SPACE SCIENCES (GENERAL)

No abstracts in this category.

## 89 ASTRONOMY

Includes radio and gamma-ray astronomy; celestial mechanics; and astrometry.

**N77-19961*#** Smithsonian Astrophysical Observatory, Cambridge, Mass.
**MINERALOGIC AND PETROLOGIC STUDY OF THE LOW-TEMPERATURE MINERALS IN CARBONACEOUS CHONDRITES Final Report**
John A. Wood [1977] 6 p refs
(Grant NsG-7132)
(NASA-CR-149811) Avail: NTIS HC A02/MF A01 CSCL 03B

Samples and petrographic thin sections of the Orgueil, Ivuna, and Alais chondrites were examined by optical, X-ray, and SEM techniques. Mineral species identified as primary vein constituents were epsomite, gypsum, and a calcium-magnesium carbonate. Relative abundances and textural relationships have suggested that fracture mineralization was a multi stage process, with individual mineralizations closely associated with impact brecciation events. Mass balance considerations of carbonaceous chondrite matrix support the prevailing view that the source of the fracture filling minerals was local. By inference they also suggest that the phyllosilicate matrix has been chemically altered and that there are probably very few primitive mineral phases in the primitive CI chondrites. Author

**N77-19962*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**X-RAY SPECTRA OF HERCULES X-1. 1: IRON LINE FLUORESCENCE FROM A SUBRELATIVISTIC SHELL**
S. H. Pravdo, R. H. Becker, E. A. Boldt, S. S. Holt, P. J. Serlemitsos, and J. H. Swank Feb. 1977 17 p refs
(NASA-TM-X-71276; X-661-77-29) Avail: NTIS HC A02/MF A01 CSCL 03A

The X-ray spectrum of Hercules X-1 was observed in the energy range 2-24 keV from August 29 to September 3, 1975. A broad iron line feature is observed in the normal high state spectrum. The line equivalent width is given along with its full-width-half-maximum energy. Iron line fluorescence from an opaque, cool shell of material at the Alfven surface provides the necessary luminosity in this feature. The line energy width can be due to Doppler broadening if the shell is forced to corotate with the pulsar at a radius > 800 million cm. Implications of this model regarding physical conditions near Her X-1 are discussed. Author

**N77-19963*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**X-RAY SPECTRA OF HERCULES X-1. 2: INTRINSIC BEAM**
S. H. Pravdo (Maryland Univ.), E. A. Boldt, S. S. Holt, and P. J. Serlemitsos Feb. 1977 15 p refs Submitted for publication
(NASA-TM-X-71277; X-661-77-31) Avail: NTIS HC A02/MF A01 CSCL 03A

The X-ray spectrum of Hercules X-1 was observed in the energy range 2-24 keV with sufficient temporal resolution to allow detailed study of spectral correlations with the 1.24 sec pulse phase. A region of spectral hardening which extends over approximately the 1/10 pulse phase may be associated with the underlying beam. The pulse shape stability and its asymmetry relative to this intrinsic beam are discussed. Author

**N77-19964*#** National Aeronautics and Space Administration. Goddard Inst. for Space Studies, New York.
**INDIRECT OBSERVATION OF UNOBSERVABLE INTERSTELLAR MOLECULES**
Eric Herbst (College of William and Mary), Sheldon Green, Patrick Thaddeus, and William Klemperer (Harvard Univ.) [1977] 41 p refs
(Grant NsG-7105)
(NASA-CR-149870) Avail: NTIS HC A03/MF A01 CSCL 03A

It is suggested that the abundances of neutral non-polar interstellar molecules unobservable by radio astronomy can be systematically determined by radio observation of the protonated

ions. As an example, observed N2H(+) column densities are analyzed to infer molecular nitrogen abundances in dense interstellar clouds. The chemistries and expected densities of the protonated ions of O2, C2, CO2, C2H2 and CH4 are then discussed. Microwave transition frequencies fo HCO2(+) and C2H3(+) are estimated, and a preliminary astronomical search for HCO2(+) is described. Author

**N77-19965#** Royal Observatory, Edinburgh (Scotland).
**STAR CLUSTERS IN THE SMALL MAGELLANIC CLOUD**
M. T. Brueck (Edinburgh Univ.) 12 Mar. 1976 15 p refs
(ROE-OR-1) Avail: NTIS HC A02/MF A01

List and charts are presented of the star clusters in the Small Magellanic Cloud observed on the UK 48-inch Schmidt plate. The list and the charts are intended to identify the clusters by coordinates and on small scale charts. ESA

**N77-19966#** British Aircraft Corp. (Operating) Ltd., Bristol (England). Electronic and Space Systems Group.
**SPACE TELESCOPE SOLAR ARRAY. FEASIBILITY STUDY. VOLUME 2: TECHNICAL REPORT Final Report**
H. Jones, comp. Oct. 1976 211 p refs
(Contract ESTEC-2643/76-NL-PP(SC))
(ESS/SS-729-Vol-2; ESA-CR(P)-884-Vol-2) Avail: NTIS HC A10/MF A01

The results of a feasibility study of the space telescope solar array are described and consideration of design is included. The selected concept with the rationale for its choice is described. A BISTEM actuated ROSA is chosen on the basis of its general compliance particularly with the dynamics, comparative simplicity, and mainly proven technology. Other candidate concepts are described and evaluated. A design description is given which includes configuration, mechanical, electrical, dynamic, and thermal aspects. Author (ESA)

**N77-19967#** AEG-Telefunken, Wedel (West Germany).
**CONCEPTUAL AND FEASIBILITY STUDY OF THE SPACE TELESCOPE SOLAR ARRAY. VOLUME 1: TECHNICAL CONCEPT**
W. Woodcock Sep. 1976 91 p
(Contract ESTEC-2645/76-NL/PP(SC))
(ESA-CR(P)-886-Vol-1) Avail: NTIS HC A05/MF A01

A conceptual design was prepared based on the flexible, deployable/ retractable Dora (Double Roll-out solar Array) concept which was developed and manufactured previously. The proposed array configuration results from a modification of previous Dora configurations to suit the severe demands of the space telescope mission - a 15 year low-earth orbit mission with periodic retrieval, ground maintenance, and relaunch. The feasibility of the proposed design is demonstrated by supporting analysis, particularly of end-of-mission electrical performance and of dynamic behavior of the flexible array. Author (ESA)

# 90 ASTROPHYSICS

Includes cosmology; and interstellar and interplanetary gases and dust.

**N77-19968*#** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
**AN OUTLINE OF PLANETARY GEOSCIENCE**
Mar. 1977 41 p
(NASA-TM-X-58202; JSC-12521) Avail: NTIS HC A03/MF A01 CSCL 03B

A philosophy for planetary geoscience is presented to aid in addressing a number of major scientific questions; answers to these questions should constitute the basic geoscientific knowledge of the solar system. However, any compilation of major questions or basic knowledge in planetary geoscience involves compromises and somewhat arbitrary boundaries that reflect the prevalent level of understanding at the time. Author

**N77-19969#** Texas Univ., Austin. Center for Particle Theory.
**APPROACHES TO THE ANALYSIS OF RELATIVISTIC SUPERDENSE MATTER**
R. L. Bowers, A. M. Gleeson, and R. D. Pedigo Jun. 1976 39 p refs
(Contract E(40-1)-3992)
(ORO-3992-256) Avail: NTIS HC A03/MF A01

Recent discoveries in astrophysics and in elementary particle theory have indicated the need for relativistic models of superdense matter. Computational schemes based on relativistic quantum field theory developed to meet these needs are discussed. An analysis of problems which arise at different levels of approximation is given, and methods are outlined for their solution. Finally, a consistent approximation scheme suited to relativistic systems is presented, and its justification discussed. ERA

**N77-19970#** State Univ. of New York, Stony Brook. Inst. for Theoretical Physics.
**PHYSICS OF NEUTRON STARS**
G. E. Brown 1976 16 p refs Presented at the Spring Meeting of the Am. Phys. Soc., Washington, D.C., May 1976
(Contract AT(11-1)-3001)
(COO-3001-148; Conf-760431-3) Avail: NTIS HC A02/MF A01

Work on the equation of state of dense matter and the consequences of this for neutron stars are briefly reviewed. Then the significance of the pion condensation which is likely to occur in neutron stars is discussed; pressure effects, cooling rates, and supernova explosions are addressed. ERA

# 91 LUNAR AND PLANETARY EXPLORATION

Includes planetology; and manned and unmanned flights.

For spacecraft design see *18 Spacecraft Design Testing, and Performance*. For space stations see *15 Launch Vehicles and Space Vehicles*.

**N77-19971*#** Rockwell International Science Center, Thousand Oaks, Calif.
**INTERNAL FRICTION Q FACTOR MEASUREMENTS IN LUNAR ROCKS Annual Report, 1 Feb. - 31 Dec. 1976**
B. R. Tittmann Feb. 1977 5 p refs
(Contract NAS9-13846)
(NASA-CR-151215; AR-3) Avail: NTIS HC A02/MF A01 CSCL 03B

Investigations to aid in the interpretation of seismic data obtained below the lunar surface are reported. Fine grained basalt with about 1.0% open core porosity was encapsulated under hard vacuum and measured. A Q value just under 2,000 at 0.5 kbar was achieved for a terrestrial analog of lunar basalt. In contrast to the modulus which increases by as much as 10%, the quality factor Q shows little or no change with pressure (a well outgassed sample maintains a high Q, whereas one exposed to laboratory atmosphere maintains a low Q). This result suggests that the absence of volatiles plays an important role in determining the q factor even at a depth of 10 km below the lunar surface. Author

**N77-19972*#** Brown Univ., Providence, R. I. Dept. of Geological Sciences.
**SIGNIFICANT ACHIEVEMENTS IN THE PLANETARY GEOLOGY PROGRAM, 1975 - 1976**
James W. Head, ed. Washington NASA Mar. 1977 36 p Sponsored by NASA
(NASA-CR-2827) Avail: NTIS HC A03/MF A01 CSCL 03B

Developments in planetology research as reported at the 1976 NASA Planetology Program Principal Investigators' meeting are summarized. Topics range from solar system evolution, comparative planetology, and geologic processes to techniques and instrument development for future exploration. Author

**N77-19973#** California Univ., Livermore. Lawrence Livermore Lab.
**MASCON AGES AND SINKING RATES**
H. C. Heard 16 Apr. 1976 19 p refs Presented at 7th Lunar Sci. Conf. on Util. of Lunar Mater. and Expertise for Large Scale Operations in Space, Houston, Tex., 15-19 Mar. 1976

(Contract W-7405-eng-48)
(UCRL-77658; Conf-760323-2) Avail: NTIS HC A02/MF A01

The long-term mechanical stability of strongly positive gravity anomalies (mascons) on the moon is evaluated from relevant physical characteristics of these bodies, from paleoselenotherms, and from the flow behavior of the lunar mantle. ERA

**N77-19974*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**SURFACE CHEMISTRY OF SELECTED LUNAR REGIONS**
Michael J. Bielefeld (Computer Sci. Corp., Silver Spring, Md.), Robert C. Reedy (Los Alamos Sci. Lab.), Albert E. Metzger (JPL), A. I. Trombka (Calif. Univ., La Jolla), and James R. Arnold 1976 31 p refs Presented at 7th Lunar Sci. Conf. on Util. of Lunar Mater. and Expertise for Large Scale Operations in Space, Houston, Tex., 15-19 Mar. 1976
(Contract W-7405-eng-36)
(NASA-TM-X-74611; LA-UR-76-972; Conf-760323-4) Avail: NTIS HC A03/MF A01 CSCL 03B

A completely new analysis has been carried out on the data from the Apollo 15 and 16 gamma ray spectrometer experiments. The components of the continuum background have been estimated. The elements Th, K, Fe and Mg give useful results; results for Ti are significant only for a few high Ti regions. Errors are given, and the results are checked by other methods. Concentrations are reported for about sixty lunar regions; the ground track has been subdivided in various ways. The borders of the maria seem well-defined chemically, while the distribution of KREEP is broad. This wide distribution requires emplacement of KREEP before the era of mare formation. Its high concentration in western mare soils seems to require major vertical mixing. ERA

# 92 SOLAR PHYSICS

Includes solar activity, solar flares, solar radiation and sunspots.

**N77-19975*#** Smithsonian Astrophysical Observatory, Cambridge, Mass.
**THE CALCULATION OF THEORETICAL CHROMOSPHERIC MODELS AND PREDICTED OSO I SPECTRA Semiannual Report, 1 Jul. - 31 Dec. 1976**
Eugene H. Avrett Feb. 1977 15 p refs
(Grant NsG-7054)
(NASA-CR-149816; SAR-3) Avail: NTIS HC A02/MF A01 CSCL 03B

A computer program was developed which, given a line list and a model atmosphere, computes a solar ultraviolet spectrum, broadens it, plots it together with an observed spectrum, and labels each line. An iterative procedure is utilized. Several of the computed and observed spectra are presented. D.M.L.

**N77-19976*#** National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
**THE ANALYSIS OF THE X-RAY EVENT ANALYZER PROPORTIONAL COUNTER DATA: A COMMENT**
Robert M. Wilson Feb. 1977 18 p refs
(NASA-TM-X-73367) Avail: NTIS HC A02/MF A01 CSCL 08B

The findings, based on a comparison of simultaneous observations of a number of flares obtained with the X-REA and SOLRAD 9 instruments, which reveal the degree of deterioration of the counters with time are presented. Author

**N77-19977*#** National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
**USER'S GUIDE TO THE DATA OBTAINED BY THE SKYLAB/ATM NASA-MARSHALL SPACE FLIGHT CENTER/THE AEROSPACE CORPORATION S-056 X-RAY EXPERIMENT**
Dec. 1976 60 p refs
(NASA-TM-X-73369) Avail: NTIS HC A04/MF A01 CSCL 03B

The S-056 observations consist of 27,000 photographs (filterheliograms) obtained by the X-ray telescope and 1,100 h of proportional counter data obtained by the X-ray event analyzer in the soft X-ray region of the solar spectrum. A description of the S-056 data together with additional relevant information that may be needed by users of the data is given. Author

**N77-19978#** Los Alamos Scientific Lab., N.Mex.
**TRANSIENT PHENOMENA IN THE SOLAR ATMOSPHERE AND SOLAR WIND**
J. T. Gosling 1976 19 p refs Presented at the Intern. Symp. on Solar Terrestrial Phys., Boulder, Colo., 7-18 Jun. 1976
(Contract W-7405-eng-36)
(LA-UR-76-1293; Conf-760645-3) Avail: NTIS HC A02/MF A01

Observations of transient disturbances in the solar atmosphere are reviewed with emphasis on two classes of coronal mass ejection events. Large flare associated events travel more than twice as fast (on the average) as the prominence associated events. Mass and energy content of the two classes may also differ, because flare associated events are massive and energetic and produce shock wave disturbances at 1 AU. The slower moving prominence events do not. ERA

**N77-19979#** Los Alamos Scientific Lab., N.Mex.
**INTERNAL PLASMA STATE OF THE HIGH SPEED SOLAR WIND AT 1 AU**
W. C. Feldman, B. Abraham-Shrawner, J. R. Asbridge, and S. J. Bame 1976 16 p refs Presented at Intern. Symp. on Solar Terrest. Phys., Boulder, Colo., 1-18 Jun. 1976
(Contract W-7405-eng-36)
(LA-UR-76-1294; Conf-760645-2) Avail: NTIS HC A02/MF A01

The character of particle velocity distributions in the high speed solar wind was investigated. It was found that electron distribution shapes differ from simple bi-Maxwellians in that a hot, strongly beamed, high energy electron component is always present and is observed to move relative to a distinct low energy electron component along the magnetic field direction, B, away from the sun. The velocity difference between hot and cold electron components appears, at times, to be strongly correlated with the local Alfven speed. The velocity of the lower density proton beam component is generally larger than that of the main component, and the temperature of the main component perpendicular to B is typically 2 to 3 times larger than its parallel temperature. Alpha particles as a whole generally move faster than the protons along B and have a temperature which is, on the average, 6 times higher than the temperature of the total proton population. ERA

**N77-19980#** National Geophysical and Solar-Terrestrial Data Center, Boulder, Colo.
**SOLAR-GEOPHYSICAL DATA NO. 383, JUL. 1976. PART 1 (PROMPT REPORTS). DATA FOR JUNE 1976, MAY 1976**
Hope I. Leighton Jul. 1976 119 p
(PB-247137-383-1; SGD-383-Pt-1) Avail: NTIS MF A01; HC Avail: Natl. Climatic Center, Attn: Publications, Federal Bldg., Asheville, N. C. 28801. Subscriptions $34.00/year includes Part 1 (Prompt Reports) and Part 2 (Comprehensive Reports); $18.00/year for either part. Annual supplement containing explanation is included. $1.50/copy for either part; $1.40 for the extra issue CSCL 03B

SMS-2 GOES satellite data are given in tables and charts for: alert periods, daily solar indices, solar flares, solar radiowaves, solar wind measurements, solar X-ray radiation, coronal holes, and inferred IP magnetic field polarities. GRA

**N77-19981#** National Geophysical and Solar-Terrestrial Data Center, Boulder, Colo.
**SOLAR-GEOPHYSICAL DATA NUMBER 383, JUL. 1976. PART 2 (COMPREHENSIVE REPORTS). DATA FOR JANUARY 1976, DECEMBER 1975 AND MISCELLANEA**
Hope I. Leighton Jul. 1976 45 p
(PB-247137-383-2; SGD-383-Pt-2; NOAA-76081702) Avail: NTIS MF A01; HC avail: Natl. Climatic Center, Attn: Publications, Federal Bldg., Asheville, N. C. 28801. Subscription $34.00/year includes Part 1 (Prompt Reports) and Part 2 (Comprehensive Reports); $18.00/year for either part. Annual supplement

containing explanation is included. $1.50/copy for either part; $1.40 for the extra issue. CSCL 03B

Data is presented on: solar flares, solar radio waves, energetic solar particles and plasma. Magnetograms of geomagnetic storms are also provided. GRA

**N77-19982#** National Geophysical and Solar-Terrestrial Data Center, Boulder, Colo.
**SOLAR-GEOPHYSICAL DATA NO. 384, AUGUST 1976. PART 1 (PROMPT REPORTS). DATA FOR JULY 1976, JUNE 1976**
Hope I. Leighton Aug. 1976 112 p
(PB-247137-384-1; SGD-384-Pt-1; NOAA-76091701) Avail: NTIS MF A01; HC Avail: Natl. Climatic Center, Attn: Publications, Federal Bldg., Asheville, N. C. 28801. Subscription $34.00/year includes Part 1 (Prompt Reports) and Part 2 (Comprehensive reports); $18.00/year for either part. Annual supplement containing explanation is included. $1.50/copy for either part; $1.40 for the extra issue. CSCL 03B

Data from SMS-2 GOES satellite is presented in tables and charts to indicate: alert periods, daily solar indices, solar flares, solar radio waves, solar X-ray radiation, coronal holes, and inferred interplanetary magnetic field polarities, daily solar activity center, sudden ionospheric disturbances, cosmic rays, geomagnetic indices, and radio propagation indices. GRA

**N77-19983#** National Geophysical and Solar-Terrestrial Data Center, Boulder, Colo.
**SOLAR-GEOPHYSICAL DATA NO. 384, AUGUST 1976. PART 2 (COMPREHENSIVE REPORTS). DATA FOR FEBRUARY 1976 - JANUARY 1976 AND MISCELLANEA**
Hope I. Leighton Aug. 1976 29 p
(PB-247137-384-2; SGD-384-Pt-2; NOAA-76091702) Avail: NTIS MF A01; HC Avail: Natl. Climatic Center, Attn: Publications, Federal Bldg., Asheville, N. C. 28801. Subscription $34.00/year includes Part 1 (Prompt Reports) and Part 2 (Comprehensive Reports); $18.00/year for either part. Annual supplement containing explanation is included. $1.50/copy for either part; $1.40 for the extra issue. CSCL 03B

Included are data concerning solar radio waves, solar flares, energetic solar particles and plasma. An abbreviated calendar record is given along with a regional flare index. GRA

**N77-19984#** Naval Research Lab., Washington, D.C.
**AN UNSTABLE ARCH MODEL OF A SOLAR FLARE Interim Report**
Daniel S. Spicer 10 Aug. 1976 143 p refs
(NRL Proj. A01-24)
(AD-A030928; NRL-A01-24) Avail: NTIS HC A07/MF A01 CSCL 03/2

The theoretical consequences of assuming that a current flows along flaring arches consistent with a twist in the field lines of these arches are examined. It is found that a sequence of magnetohydrodynamic (MHD) and resistive MHD instabilities driven by the assumed current (which is referred to as the toroidal current) can naturally explain most manifestations of a solar flare. The principal flare instability in the proposed model is the resistive kink (or tearing mode in arch geometry) which plays the role of thermalizing some of the field energy in the arch and generating X-configured neutral points needed for particle acceleration. The difference between thermal and nonthermal flares is elucidated and explained, in part, by amplitude-dependent instabilities, generally referred to as overlapping resonances. The criteria for the generation of flare shocks strongly depend on the magnitude and gradient steepness of the toroidal current, which also are found to determine the volume and rate of energy release. The resulting model is in excellent agreement with present observations and has successfully predicted several flare phenomena. Author (GRA)

**N77-19098*#** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**A SOLAR PLASMA STREAM MEASURED BY DRVID AND DUAL-FREQUENCY RANGE AND DOPPLER RADIO METRIC DATA**
F. B. Winn, S. C. Wu, T. A. Komarek, V. W. Lam, H. N. Royden, and K. B. W. Yip *In its* The Deep Space Network 15 Feb. 1977 p 43-54 refs (For primary document see N77-19091 10-12)
Avail: NTIS HC A13/MF A01 CSCL 03B

**N77-19113*#** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**PRECISION INSOLATION MEASUREMENT UNDER FIELD CONDITIONS**
M. S. Reid and R. A. Gardner *In its* The Deep Space Network 15 Feb. 1977 p 169-175 refs (For primary document see N77-19091 10-12)
Avail: NTIS HC A13/MF A01 CSCL 03B

**N77-19118*#** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**SOLAR PLASMA: VIKING 1975 INTERPLANETARY SPACECRAFT DUAL-FREQUENCY DOPPLER DATA**
S. C. Wu and F. B. Winn *In its* The Deep Space Network 15 Feb. 1977 p 204-223 refs (For primary document see N77-19091 10-12)
Avail: NTIS HC A13/MF A01 CSCL 03B

## 93 SPACE RADIATION

Includes cosmic radiation and inner and outer earth's radiation belts.

For biological effects of radiation see *52 Aerospace Medicine*. For theory see *73 Nuclear and High-Energy Physics*.

**N77-19985#** Lockheed Missiles and Space Co., Palo Alto, Calif.
**HYDROMAGNETIC STRUCTURE OF INTERPLANETARY FLUX FROM THE POWERFUL FLARE OF 4 AUGUST 1972**
E. G. Eroshenko and K. G. Ivanov [1976] 7 p refs Transl. into ENGLISH from Geomagn. i Aeron. (USSR), v. 16, no. 6, 1976 p 970-975
Avail: NTIS HC A02/MF A01; National Translation Center, John Crerar Library, Chicago, Illinois 60616

The sun-earth phenomena of 4 and 5 August 1972 were the brightest in the whole history of space research. Their detailed analysis yielded information about the hydromagnetic structure of the flux of interplanetary plasma from a scale 3B powerful solar flare observed at 6 hrs 21 min UT on 4 August in the 15 N, 9 E helicoordinate range. An analysis of magnetic measurements in interplanetary space near earth indicates that the interplanetary flux from the powerful August 4 flare was one of typical flux modifications, and substantially oblique inflow of the fundamental structural flux elements on the set of near-earth space vehicles and double intersection of the flare plasma occurred because of fluctuations in its position in space. Author

**N77-19986*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**OBSERVATIONS OF GALACTIC COSMIC RAY ENERGY SPECTRA BETWEEN 1 AND 9 AU**
F. B. McDonald, N. Lal, M. A. I. VanHollebeke, J. H. Trainor, and W. R. Webber (N. H. Univ.) Feb. 1977 39 p refs
(NASA-TM-X-71270; X-660-77-26) Avail: NTIS HC A03/MF A01 CSCL 03B

The variation of the 5 to 500 MeV/nuc cosmic ray helium component was studied between 1 and 9 A.U. using essentially identical detector systems on Pioneer 10 and 11 and Helios I. Between 100 and 200 MeV/nuc a radial gradient of $3.3 \pm 1.3\%$/A.U. is found. At 15 MeV/nuc this value increases to $20 \pm 4\%$/A.U. Between 4 and 9 A.U. a well defined intensity maximum is observed at approximately 17 MeV/nuc. The average adiabatic energy loss between 1 and 9 A.U. is approximately 4 MeV/nuc/A.U. The observed radial variation between 1 and 9 A.U. is well described by the Gleeson-Axford force field solution of the modulation equations over an energy range extending from 15 to 500 MeV/nuc and is in good agreement with the results reported by other Pioneer experiments. These values are much smaller than had been theoretically predicted. Author

**N77-19987*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**WORST-CASE SPACE RADIATION ENVIRONMENTS FOR GEOCENTRIC MISSIONS**
E. G. Stassinopoulos and S. M. Seltzer (NBS, Washington, D. C.) Dec. 1976 7 p Presented at the IEEE Ann. Conf. on Nucl. and Space Radiation Effects, Williamsburg, Va., Dec. 1976 Submitted for publication

(NASA-TM-X-71272; X-601-76-294) Avail: NTIS HC A02/MF A01 CSCL 03B

Worst-case possible annual radiation fluences of energetic charged particles in the terrestrial space environment, and the resultant depth-dose distributions in aluminum, were calculated in order to establish absolute upper limits to the radiation exposure of spacecraft in geocentric orbits. The results are a concise set of data intended to aid in the determination of the feasibility of a particular mission. The data may further serve as guidelines in the evaluation of standard spacecraft components. Calculations were performed for each significant particle species populating or visiting the magnetosphere, on the basis of volume occupied by or accessible to the respective species. Thus, magnetospheric space was divided into five distinct regions using the magnetic shell parameter L, which gives the approximate geocentric distance (in earth radii) of a field line's equatorial intersect. Author

**N77-19988#** Brookhaven National Lab., Upton, N.Y.

**IMPLICATIONS FOR NEW PARTICLE SEARCHES OF SOME COSMIC RAY EMULSION EVENTS**

T. K. Gaisser Mar. 1976 5 p refs Presented at Conf. on Particle Searches and Discoveries, Nashville, 1 Mar. 1976

(BNL-21124; Conf-760344-3) Avail: NTIS HC A02/MF A01

Calculations of backgrounds for cosmic ray candidates for new particles in emulsions are summarized. Even if only the strongest cosmic ray candidates are accepted as genuine, the implication is that their production cross sections would be relatively large at accelerator energies (greater than or equal to 1 micron b and that decay modes with pi sub o appear to be prominent. Current accelerator upper bounds on sigma x B/sub K pi/ for production of hadrons with M greater than 2 GeV and the relation between these bounds and the cosmic ray events are discussed. ERA

## 99 GENERAL

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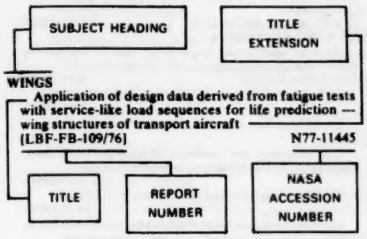


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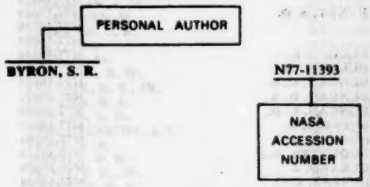


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DER, Z. A. N77-19294
DESHAZER, L. G. N77-19393
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DEVORE, R. W. N77-19454
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DIENES, G. J. N77-19904
DIETZ, J. B. N77-19149
DILUZIO, R. G. N77-19958
DIMEFF, J. N77-19388
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DITTBENNER, G. R. N77-19361
DOBBERPUHL, D. A. N77-19866
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DOLAND, G. D. N77-19320
DOLE, M. N77-19265
DOMAN, G. S. N77-19058
DONAGHEY, L. F. N77-19644
DONAKOWSKI, T. N77-19667
DONNELLEY, J. E. N77-19926
DORAN, J. C. N77-19359
DORNBUSH, J. N. N77-19955
DORY, R. A. N77-19881
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DRANE, C. N77-19313
DRANE, D. A. N77-19014
DRAUT, C. F. N77-19480
DREGALIN, A. F. N77-19271
DRESNER, L. N77-19910
DRESSER, H. S. N77-19077
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DUKET, S. D. N77-19085
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DULL, D. L. N77-19244
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DUPRIEZ, F. N77-19047
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DURHAM, G. N. N77-19950
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ECHEVERRIA, A. W. N77-19194
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EDEN, J. G. N77-19896
EDWARDS, D. N77-19549
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EERNISSE, E. P. N77-19336
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EGELAND, A. N77-19542
EHLERS, G. F. L. N77-19169
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ELKINS, R. H. N77-19667
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EROSHENKO, E. G. N77-19985
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EVANS, W. H. N77-19922
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FEELY, H. W. N77-19728
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**FROST, J. D., JR.** N77-19746
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**FUCINARI, C. A.** N77-19470
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**GUSEVA, N. B.** N77-19130
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**HOLZAPFEL, W.** N77-19433
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**HOVEL, H.** N77-19576
**HOWE, T. W.** N77-19094
**HOWERTER, E. D.** N77-19524
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**HU, H.** N77-19248
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**HUGHES, T. J. R.** N77-19513
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**HUNT, R. A.** N77-19067
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**HWANG, H. H.** N77-19580
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**IKEZI, H.** N77-19871
**ILES, P. A.** N77-19573
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**IRANI, R. C.** N77-19250
**IRELAND, C. T.** N77-19805
**IRWIN, G. R.** N77-19527
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**IVANOV, K. G.** N77-19985
**IVINS, R. O.** N77-19593
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**IZMEROV, N. F.** N77-19680

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**JACKSON, D. O.** N77-19066
**JAGGARD, D. L.** N77-19288
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**JAMES, M. R.** N77-19517
**JAVAN, A.** N77-19912
**JEFFERS, M. F.** N77-19286
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**JONES, W. L.** N77-19744
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KAHANER, D. K. N77-19813
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KIPP, M. E. N77-19493
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KIRSCH, L. N77-19854
KISHI, T. N77-19800
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KLOPFSTEIN, G. N77-19052
KNOWLES, J. K. N77-19514
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KRESSEL, H. N77-19863
KRUPKE, W. F. N77-19429
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LAMBERT, F. J., JR.
LAMBOURNE, N. C.
LAMBREGTS, A. A.
LAMPERT, E.
LANCE, R. H.
LAND, J. F.
LAND, M. E.
LANDAU, U.
LANDAUER, C.
LANDRY, J. D.
LANE, R. A.
LANGHOFF, P. W.
LANGLEY, R. A.
LANSING, F. L.
LANTZ, J. B.
LAPADULA, L. J.
LARDER, R. A.
LARSON, D. J., JR.
LASALLE, J. P.
LASSETTRE, E. N.
LATIF, A.
LAUDENSLAGER, J. B.
LAUE, E. G.
LAURANCE, R. J.
LAWRENCE, J.
LAWSON, D. D.
LAWTON, R. G.
LAY, R.
LEDBETTER, H. M.
LEDERER, R. A.
LEE, J.
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LEE, S. T.
LEE, W. W.
LEGUILLY, G.
LEHNERT, B.
LEIGHTON, H. I.
LEILICH, R. H.
LEMMON, R. M.
LENOIR, M.
LENSEIGNE, C.
LEO, P. P.
LEONARD, R. F.
LEROY, L.
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LESTER, J. D.
LEVINE, G. S.
LEVITT, B. K.
LEVY, S. J.
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LEWIS, P. A. W.
LIBBY, W. F.
LICHTNER, P. C.
LIEBER, A. J.
LIGON, C.
LINEBERGER, W. C.
LINGSCHEIT, J. N.
LINS, H. F., JR.
LIPOW, M.
LIU, C. R.
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LIZON-TATI, J. A. F.
LOHR, H.
LOMAX, H.
LONDON, R. L.
LORDI, J. A.
LORING, P. L.
LOSCUTOFF, W. V.
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LOWRIE, B. W.
LUDWIG, G. R.
LUEBBERS, R. J.
LUNDBERG, L. B.
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LYNCH, F. E.
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MADER, C. L.
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MAIER, M. W.
MAILLOUX, R.
MAIYA, P. S.
MAJUMDAR, S.
MAKHMUTOV, I. M.
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MANHEIMER, W. M.
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OSOWSKI, D. M. N77-19635
OSTERYOUNG, R. A. N77-19203
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OTOOLE, J. W. N77-19157
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PETERKA, J. A. N77-19716
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PETERS, B. C., JR. N77-19824
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PHARES, W. J. N77-19024
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PLEVA, R. M. N77-19306
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POLILOV, A. N. N77-19172
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PROSCHAN, F. N77-19160
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RAO, A. D. P. N77-19691
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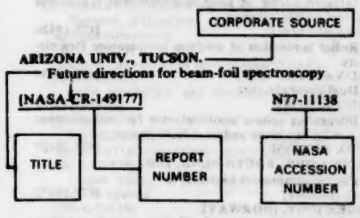


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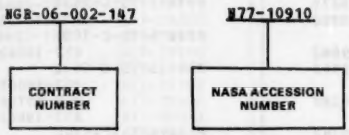


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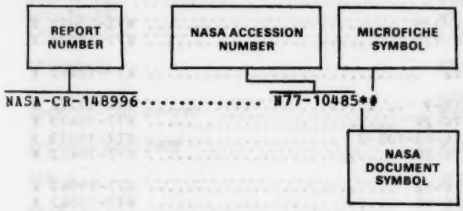


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